ABSTRACTS OF NORTH AMERICAN GEOLOGY

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INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals, but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with limited circulations (such as dissertations, open-file reports, or memorandums) or of other papers presented orally at meetings.

The Abstracts will be an additional reference tool but will not replace the Bibliography of North American Geology, which has been published by the Geological Survey since 1887. Twelve monthly issues of Abstracts of North American Geology will be published each year. The Bibliography will include citations and subject index for a calendar year.

Abstracts of North American Geology and the Bibliography are being prepared by use of computer techniques. Each abstract along with its indexing is placed on magnetic tape and entered into a permanent data bank. The material prepared each month will be published in the form of the present issue. The abstracts are arranged alphabetically according to senior author. A subject index follows the abstracts and is designed for rapid reference to any subject desired. Bibliographies can subsequently be retrieved according to the terms used in the index.

The abstracts in this issue were prepared by H. R. Blank, Jr., Georgianna D. Conant, W. C. Culbertson, K. A. Dickinson, Wanda L. Grimes, Bettie S. Hackman, W. P. Irwin, Virginia M. Jussen, B. H. Kent, A. R. Kinkel, Jr., B. F. Leonard, Elisabeth S. Loud, Mildred C. Mead, D. R. Mullineaux, A. E. Nelson, Virginia S. Neuschel, J. J. Norton, D. W. Rankin, M. W. Reynolds, A. E. Roberts, D. C. Ross, E. T. Ruppel, Anne C. Sangree, S. P. Schweinfurth, H. W. Smedes, Ruth Todd, Dorothy B. Vitaliano, J. W. Whitlow, and R. E. Wilcox.

ABSTRACTS

8522 **Adami, L. H.; Conway, K. C.** Heats and free energies of formation of anhydrous carbonates of barium, strontium, and lead: U.S. Bur. Mines Rept. Inv. 6822, 7 p., tables, 1966.

The heats of formation of anhydrous barium carbonate (witherite), strontium carbonate (strontianite), and lead carbonate (cerussite) were determined by solution calorimetry. The solution mediums were hydrochloric acid for barium and strontium carbonates and perchloric acid for lead carbonate. The heats of formation at 298.15°K are as follows: $BaCO_3$, -297.5 ± 0.8 kcal/mole, $SrCO_3$, -294.6 ± 0.5 kcal/mole; and $PbCO_3$, -168.0 ± 0.3 kcal/mole.—H.R.B.

8530 **Agarwal, R. K.; Boshkov, S.** Theory of the 'soft inclusion' as a deformation gauge in boreholes: Internat. Jour. Rock Mechanics and Mining Sci., v. 3, no. 4, p. 319–323, tables, 1966.

The possibility of developing an instrument based on 'solid inclusion' principle where the ratio of Young's moduli of the insert and host rock is very low . . . has not been explored explicitly. The paper contains the theoretical development, defining the conditions under which a 'soft inclusion' may prove to be a valuable device. It is felt that such a device in conjunction with the moire fringe technique of measuring displacement may provide all the information required to find the directions and magnitudes of the principal strains and hence the principal stresses in a plane, when the 'stress relief' technique of stress measurement is used.—Authors' abstract

Aitkens, D. S. W. *See* Saint-Onge, D. 8880

8765 **Akpati, Benjamin N.** Some Lower Paleocene Foraminifera from the Anita Formation, Santa Barbara County, California: Cushman Found. Foram. Research Contr., v. 17, pt. 4, p. 135–139, illus., 1966.

Eight foraminiferal species [seven new] are described from the Anita Formation, Lower Paleocene (Ynezian), Western Santa Ynez Mountains. They represent the genera *Quadratobuliminella* (Turrilinidae), *Yneziella* new genus [three new species] (Eovigerinidae), *Dentalina and Vaginulina* (Nodosariidae), *Ellipsopolymorphina* (Pleurostomellidae) and *Coryphostoma* (Caucasinidae). The fauna is correlative to that of the Midway Group of the Gulf Coast and is also similar to that of the Danian of the Bavarian Alps and France.—*from* Author's abstract

8423 **Albanese, John S.** Metamorphism—How it works to create new minerals: Gems and Minerals, no. 345, p. 30–31, 1966.

The general meaning of metamorphism is reviewed, and examples of hydrothermal contact metamorphism, including the minerals formed, in various types of rock are described.—E.S.L.

8887 **Albert, C. D.; Stramel, G. J.** Fluvial sediment in the Little Arkansas River basin, Kansas: U.S. Geol. Survey Water-Supply Paper 1798-B, p. B1–B30, illus., table, 1966.

Information is presented on the quantity and characteristics of sediment transported by the Little Arkansas River of south-central Kansas. Evaluation of the effect of the sediment on water for municipal supply and for artificial recharge of ground water suggests that recharge by well-injection is not feasible but that recharge by water spreading over large permeable areas may be feasible.—W.L.G.

8565 **Algermissen, S. T.; Cloud, W. K.** The Coast and Geodetic Survey programs in engineering seismology [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Div. Mtg. Solid Earth Physics I, p. 43, 1966.

8453 **Anderson, Barbara Jean.** Methods of detecting compositional differences in some common zeolites [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 898B, 1966.

Anderson, David N. *See* Land, P. E. 8502

8389 **Anderson, Don L.** The present status of free oscillation interpretations [abs.], *in* Internat. Symposium Geophys. Theory and Computers, 2d, Rehovoth, Israel, 1965, Proc.: Royal Astron. Soc. Geophys. Jour., v. 11, nos. 1–2, p. 255, 1966.

8787 **Anderson, Raymond J.; Graf, Donald L.; Jones, Blair F.** Calcium and bromine contents of natural waters [reply to discussion of 1966 paper by P. C. Mangelsdorf, Jr., 1966]: Science, v. 154, no. 3755, p. 1473, 1966.

The new unit-slope line, as defined by Mangelsdorf (ibid., p. 1473) in his criticism of an earlier paper by Anderson, Graf, and Jones (ibid., v. 153, p. 1637, 1966) is fictive though useful. The common source of Ca^{++} and Br^{-} suggested for the Dead Sea and Michigan basin chloride brines is seawater modified to a considerable extent by ultrafiltration, dolomitization, and freshwater infiltration in the two areas. Sets of subsurface samples from areas with different hydrodynamic histories would not fall on the line. The line does involve a coincidence between two geographic regions and is of significance not for its position but for its slope.—D.B.V.

Anderson, Robert A. *See* Harrison, Frank W. 8464

8436 **Anikouchine, William Alexander.** A model of the distribution of dissolved species in interstitial water in clayey marine sediments [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 855B, 1966.

8842 **Appel, Charles A.** Approximating steady linear flow in a confined aquifer of nonuniform thickness, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D214–D216, illus., table, 1966.

Formulas are given for steady linear flow in a section of an "ideal" confined nonleaky aquifer having the shape of two or more partial wedges connected end to end in such a way that the thickness change is nowhere abrupt. The formulas are for the case where the top and bottom surfaces of each wedge intersect the horizontal at angles whose tangents are not greater than 0.2. Analysis of the formula for a partial wedge indicates that the use of the average aquifer thickness, with Darcy's law, gives estimates of flow with sufficient accuracy for most applications, where the changes in thickness are not very large.—Author's abstract

8387 **Archambeau, C.** Automated inversion of seismic field amplitude-time properties for crust and upper mantle structure [abs.], *in* Internat. Symposium Geophys. Theory and Computers, 2d, Rehovoth, Israel, 1965, Proc.: Royal Astron. Soc. Geophys. Jour., v. 11, nos. 1–2, p. 254, 1966.

Arnold, James R. *See* Urey, Harold C. 8811

Baadsgaard, H. *See* Folinsbee, R. E. 8657

8400 **Baker, A. F.; Brady, G. A.; Eckert, J. W.** A method for determining the electrical resistivity of solid anthracite specimens: U.S. Bur. Mines Rept. Inv. 6788, 18 p., illus., tables, 1966.

Techniques were developed and circuitry was assembled for measuring the total and volume resistances to the flow of electric current through solid specimens of anthracite. The two-, three-, and four-terminal test methods demonstrated the extreme sensitivity of resistivity to differences in anthracite characteristics and showed response to changes resulting from variations in structure, temperature, and moisture content.—H.R.B.

8783 **Balbach, Margaret Kain.** Microspore variation in *Lepidostrobus* and comparison with *Lycospora*: Micropaleontology, v. 12, no. 3, p. 334–342, illus., 1966.

The range of variation of the microspores of five species of the Paleozoic lycopod cone *Lepidostrobus* is reported [Pennsylvanian, Des Moines Series, central U.S.]. Size is fairly constant but, for some features, variation exists which, if observed in dispersed spores, might be interpreted as specific differences. Structure of the microspores was determined in part by sectioning. At this time, none of the cone microspores were found unequivocally referable to any species of *Lycospora*.—Author's abstract

8514 **Baldwin, Ewart M.** Geology of the Columbia River gorge: Northwest Sci., v. 40, no. 4, p. 121–128, illus., 1966.

As part of a symposium on the natural history of the Columbia River Gorge, this paper reviews the stratigraphy and structural geology of the basalt flows and sedimentary formations, formation of the gorge, and effects of the Missoula Flood near the end of the Wisconsin ice stage and of landslides.—G.D.C.

Baldwin, H. L. *See* Harshbarger, J. W. 8889

Banner, F. T. *See* Blow, W. H. 8781

Baptist, O. C. *See* White, E. J. 8395

8399 **Barany, Ronald.** Glass–crystal transformation of nepheline and wollastonite and heat of formation of nepheline: U.S. Bur. Mines Rept. Inv. 6784, 8 p., tables, 1966.

The heats of the glass–crystal transformation of nepheline ($Na_{0.7794}K_{0.2206}AlSiO_4$) and wollastonite ($CaSiO_3$) and the heat of formation of nepheline at 298.15°K were determined by solution calorimetry. For the glass–crystal transformations, the heat values are -9.0 ± 0.3 kcal/mole for nepheline and -8.1 ± 0.2 kcal/mole for wollastonite. The heat of formation of nepheline is -34.8 ± 0.6 kcal/mole from the oxides and -501.0 ± 0.5 kcal/mole from the elements.—H.R.B.

8578 **Barnes, I. L.; Naughton, J. J.; Finlayson, J. B.** Analysis of trace components in volcanic gases [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Div. Mtg. Solid Earth Physics II, p. 39, 1966.

Barnes, I. L. *See* Naughton, J. J. 8579

8694 **Barnes, Robert H.** Mineral resources summary of the Sandy Hook quadrangle, Tennessee: Nashville, Tennessee Div. Geology, 14 p., table, 1966.

This text accompanies Tennessee Div. Geology Geol. Map GM 58-NW by C. W. Wilson, Jr. (cited separately). The only mineral resource mined in the Sandy Hook quadrangle is phosphate; all areas of previous mining and all known reserves are within the outcrop belt of the Bigby–Cannon Limestone which includes about 5,000 acres. Future developments may make the small, impure deposits in the Catheys, Leipers, and Hermitage Formations commercially valuable. Several formations are possible sources of limestone and there are reserves of chert in the Fort Payne Formation.—M.C.M.

8696 **Barr, David I. H.** Bed forms due to a fluid stream—Discussion [of paper 4724 by H. M. Hill, 1966]: Am. Soc. Civil Engineers Proc., v. 92, Jour. Hydraulics Div., no. HY 6, p. 226–227, 1966.

Barr considers Bagnold's experiments as described by Hill, from a different point of view, and concludes that Hill should support his own potentially valuable theory of bed forms by a rigorous use of the theory of similitude.—E.S.L.

Barr, David I. H. *See* Flaxman, Elliott M. 8697

8698 **Barr, David I. H.; Herbertson, John G.; Maddock, Thomas, Jr.** Hydraulic resistance of alluvial streams—Discussions [of paper 4739 by Frank Engelund, 1966]: Am. Soc. Civil Engineers Proc., v. 92, Jour. Hydraulics Div., no. HY 6, p. 257–262, 1966.

Barr and Herbertson believe that the various notations and conventions adopted for a discussion of sediment transport phenomena can best be correlated by converting them into terms of dynamic velocities, imposed velocities, and other imposed flow characteristics. Such conversion aids in understanding Engelund's paper, and also draws attention to the fact that he has not attempted to distinguish fully between the circumstances of flume testing of a mobile bed and the stable existence of a natural channel across a plain of mobile material. Maddock finds that data based on Engelund's flume experiments cannot be extrapolated to natural streams, and will not fit many flume data. In nature and in flumes there are certain constraints operating which make some relationships more probable than others.—E.S.L.

Barry, A. *See* Howell, Lynn G. 8435

8463 **Bayer, Thomas Norton.** The Maquoketa Formation in Minnesota and an analysis of its benthonic communities [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 855B–856B, 1966.

Becher, Albert E. *See* Meisler, Harold. 8663

8352 **Beck, Myrl E., Jr.** The effect of magmatic differentiation on the magnetic properties of diabase sheets of southeastern Pennsylvania, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D109–D116, illus., table, 1966.

Specimens from six differentiated sheets of Triassic diabase from southeastern Pennsylvania show a marked increase in remanent and induced magnetic intensity accompanying crystal fractionation. This increase in magnetic moment probably reflects absolute enrichment in total iron, accompanied by a rise in the relative importance of ferric iron, in passing from mafic to felsic differentiates. In gently dipping sheets there is a tendency for residual fluids to concentrate near the top of the sheet, and this process may produce marked asymmetry in aeromagnetic profiles across such sheets. Especially high stability of remanent magnetization seems to be associated with the mafic fraction.—Author's abstract

Beck, Myrl E., Jr. *See* Books, Kenneth G. 8353

8379 **Beebe, B. W.; Downs, George R.** John Haviland Maxson (1906–1966): Am. Assoc. Petroleum Geologists Bull., v. 50, no. 11, p. 2483, portrait, 1966.

8567 **Belshé, J. C.** The magnetism of Pacific sediments [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Div. Mtg. Solid Earth Physics II, p. 2, 1966.

8569 **Belshé, J. C.; Cropper, A. G.; Langford, S. A.** The Tuscarora sea mount province of the Hawaiian trough [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Div. Mtg. Solid Earth Physics II, p. 4, 1966.

8462 **Belsky, Theodore.** Chemical evolution and organic geochemistry [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 856B, 1966.

8540 **Benassini, Aurelio.** Tratamiento de cimentaciones de cortinas [with English, French and Portuguese abs.]: Rev. Ingeniería Hidrául. México, v. 20, no. 1, p. 7–32, illus., table, 1966.

The contact between a dam's wall and foundation rock is a vital part of the structure, but information about the zone is usually not known until bedrock is exposed or additional exploration has been done. Foundation treatment discussed here applies to earth dams as well as to earth and rock dams common in Mexico, and includes rock both in river beds and on hillsides. Alteration, structural conditions, and discordances vary at each site. Resistance, permeability, and compressibility of foundation rocks must be known, and whether they outcrop, are covered by alluvial fill to an accessible depth, or fill too deep for a rock foundation. Treatment includes cleaning and consolidating of fractures, faults, and caves, and injection and preparation of foundation surface.—E.S.L.

8769 **Berkstresser, Charles F., Jr.; Mourant, Walter A.** Ground-water resources and geology of Quay County, New Mexico: New Mexico Bur. Mines and Mineral Resources Ground-water Rept. 9, 115 p., illus., tables, geol. map, 1966.

Rocks exposed in Quay County, N. Mex., range from Triassic to Recent. Quaternary alluvium yields as much as 325 gpm of water, the Ogallala Formation as much as 1,600 gpm, and the Entrada, 250 gpm. Other aquifers supply domestic and stock requirements. Concentrations of sulfate in 142 samples range from 11 to 3,190 ppm with about half containing more than 250 ppm. In the southern part of the county, water levels declined about 30 feet between 1942 and 1964, but east of Tucumcari have risen about 40 feet due to recharge from irrigation. Records of selected wells in Quay and adjoining counties, 13 well logs, a ground-water and a geologic map with sections accompany the report.—E.S.L.

8580 **Berry, Frederick A. F.** Role of membrane hyperfiltration on the origin of the thermal brines, Imperial Valley, California [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Div. Mtg. Solid Earth Physics II, p. 43, 1966.

Berry, W. B. N. *See* Osborne, F. Fitz. 8779

Bianchi, W. C. *See* Haskell, E. E., Jr. 8499

8518 **Bieberman, Robert A.; Grandjean, Mary Ann.** Petroleum developments in New Mexico during 1960: New Mexico Bur. Mines and Mineral Resources Circ. 72, 67 p., illus., tables, 1966.

Petroleum provided almost 68 percent of the total value of all minerals produced in the state during 1960; production of crude oil and distillate amounted to 107,365,148 bbls. Natural gas production amounted to 821,914,616,000 cubic feet. New Mexico ranks seventh in the production of crude oil and fourth in production of natural gas in the United States. A total of 1,798 wells was drilled, a decrease of 305 tests from 1959; total footage drilled increased slightly, and average depth per well increased from 4,148 feet in 1959 to 5,078 feet in 1960. Wells completed during 1960 are listed along with location, completion date, initial production, elevation, top of pay, and producing formation for each well.—*from* Authors' abstract

8729 **Bieberman, Robert A.; Whitmore, Sharyn.** (compilers). Index to samples from oil and gas well tests in library at Socorro, New Mexico, July 1, 1961 to July 1, 1966: New Mexico Bur. Mines and Mineral Resources Circ. 88, 11 p., table, 1966.

Since the collection of samples from oil and gas well tests was commenced in 1927, it has grown to its present size of over 7,200 wells from all parts of New Mexico. The collection provides a state-wide record of subsurface stratigraphy.—M.C.M.

8443 **Binder, Charles Regis.** Electron spin resonance—Its application to the study of thermal and natural histories of organic sediments [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 796B–797B, 1966.

8421 **Bingham, James W.; Grolier, Maurice J.** The Yakima Basalt and Ellensburg Formation of south-central Washington: U.S. Geol. Survey Bull. 1224-G, p. G1–G15, illus., 1966.

The uppermost part of the Yakima Basalt—herein assigned to the Columbia River Group—has five largely conformable units; sedimentary deposits of the Ellensburg Formation interfinger with flows of the youngest member, the Frenchman Springs. The basalt is about 4,500 feet thick at a test well in the Odessa area, and probably is much thicker toward the center of the Columbia Plateau; the part described has a composite thickness of about 1,200 feet above the Vantage Sandstone Member. The overlying and interfingering Ellensburg Formation is as thick as 2,000 feet in the type area, and the Beverly Member (lower part of the Ellensburg in the Sentinel Gap area) is 300 feet. Yakima Basalt is late Miocene and early Pliocene in age.—*from* Authors' abstract

8388 **Birch, F.** Evidence from high-pressure experiments bearing on the density and composition of the Earth [abs.], *in* Internat. Symposium Geophys. Theory and Computers, 2d, Rehovoth, Israel, 1965, Proc.: Royal Astron. Soc. Geophys. Jour., v. 11, nos. 1–2, p. 256–257, 1966.

Blake, W., Jr. *See* Dyck, W. 8750

8781 **Blow, W. H.; Banner, F. T.** The morphology and biostratigraphy of *Globorotalia barisanensis* LeRoy, *Globorotalia fohsi* Cushman and Ellisor, and related taxa: Micropaleontology, v. 12, no. 3, p. 286–302, illus., 1966.

Bolli (1950) distinguished four successively developing "subspecies" within *Globorotalia fohsi* (s.l.) which he used for the subdivision of the zone of Cushman and Stainforth (1945) in the late Tertiary Cipero Formation of Trinidad; correlations were later extended to many other parts of the world. The new species *Globorotalia (Turborotalia) peripheronda, G. (T.) periferacuta, G. (Globorotalia) praefohsi* are here proposed for forms preceding *G. (G.) fohsi* in progressive development of the imperforate carina; stratigraphic succession is shown to follow this lineage. Variations in the perforate pseudo-carina, used as criteria by Bolli, have no direct relation to stratigraphic horizon. *G. barisanensis* differs from *G. fohsi* only in the latter characters, so is considered a junior synonym.—V.M.J.

8869 **Blume, John A.** Earthquake ground motion and engineering procedures for important installations near active faults, *in* World Conf. Earthquake Eng., 3d, New Zealand, 1965, Proc., V. 3: Wellington, New Zealand Inst. Engineers, p. IV–53–IV–71, illus., tables, 1965 [1966].

Costly or sensitive buildings, structures, and facilities are being constructed in active earthquake areas throughout the world. Building codes and normal design practices are not always compatible with the inherent risks. This paper outlines procedures for site studies and site selection, evaluation of seismic probability and risk, a new approach to ground motion based upon soil and rock properties, response spectra, inelastic design criteria, and related matters, in the light of current (limited) knowledge. Hypothetical examples are based upon experience with nuclear power plants and major research facilities close to active faults. Analytical, empirical, philosophical, and practical considerations are reconciled.—Author's abstract

8707 **Bolton, Thomas E.** Some Late Silurian Bryozoa from the Canadian Arctic Islands: Palaeontology, v. 9, pt. 3, p. 517–522, illus., 1966.

One new species of trepostome, *Diplotrypa franklini*, and two species of cyclostome, *Fistulipora(?) mutabilis* Hennig and *Cyclotrypa silurica* Hennig originally described from the Ludlovian rocks of Gotland are characteristic of the Early Ludlovian shelly faunas scattered throughout the Canadian Arctic Islands.—Author's abstract

8353 **Books, Kenneth G.; White, Walter S.; Beck, Myrl E., Jr.** Magnetization of Keweenawan gabbro in northern Wisconsin and its relation to time of intrusion, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D117–D124, illus., tables, 1966.

The average direction of remanent magnetization for gabbro that is intrusive into steeply dipping middle Keweenawan lavas in northern Wisconsin is similar to directions measured by P. M. DuBois, of the Canada Geological Survey, for the Portage Lake Lava Series, the Copper Harbor Conglomerate, and the Duluth

Gabbro Complex in the Lake Superior region. If the direction of remanent magnetization for the gabbro in Wisconsin is rotated to eliminate the effect of tilt in the enclosing lavas, the similarity is destroyed. This suggests that the gabbro intrusion occurred after tilting. Further analysis of all significant paleomagnetic data for the region appears to limit intrusion of the gabbro in northern Wisconsin to the late Keweenawan.—Authors' abstract

8474 **Bornhauser, Max** Marine unconformities in northwestern Gulf Coast [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2320, 1966.

Boshkov, S. *See* Agarwal, R. K. 8530

8434 **Bott, M. H. P.; Smith, R. A.; Stacey, R. A.** Estimation of the direction of magnetization of a body causing a magnetic anomaly using a pseudogravity transformation: Geophysics, v. 31, no. 4, p. 803–811, illus., tables, 1966.

A two-dimensional form of the pseudogravity transformation, applicable to bodies magnetized in directions not parallel to the ambient field, is given. An adaptation of this transformation enables the direction of magnetization of the body to be estimated, within limits, from the magnetic anomaly it causes. The method has been programmed for a computer. A simple extension enables it to be applied to three-dimensional bodies. Tests against calculated magnetic profiles over geometrical shapes show the method to be reliable. Applied to the Lambay magnetic anomaly in the Irish Sea, it indicates a body magnetized approximately in the direction of the present Earth's field.—D.B.V.

8872 **Bouwer, Herman.** Rapid field measurement of air entry value and hydraulic conductivity of soil as significant parameters in flow system analysis: Water Resources Research, v. 2, no. 4, p. 729–738, illus., tables, 1966.

Field measurements of air entry value and hydraulic conductivity of soil are obtained with a covered cylinder infiltrometer equipped with standpipe and vacuum gage. Tests are normally completed in approximately 30 minutes. The resulting data are used to construct step functions relating hydraulic conductivity to (negative) soil water pressure for sorption and desorption. These functions may be used as simplified hydraulic conductivity characteristics to include negative-pressure flow in the analysis of subsurface water movement. Several field and laboratory studies demonstrate the validity of the concepts and the technique.—Author's abstract

8496 **Brace, W. F.; Paulding, B. W., Jr.; Scholz, C.** Dilatancy in the fracture of crystalline rocks: Jour. Geophys. Research, v. 71, no. 16, p. 3939–3953, illus., tables, 1966.

Volume changes in granite, marble, and aplite were measured during deformation in triaxial compression at confining pressures up to 8 kb. At low stress the changes are purely elastic. At maximum stresses of 1/3–2/3 the fracture stress at a given pressure the rocks become dilatant, the magnitude of the dilatancy ranging from 0.2 to 2.0 times the purely elastic volume change. For granite, the stress at which dilatancy was first detected was strongly time-dependent; the higher the loading rate the higher the stress. Dilatancy, which represents an increase in porosity, was traced in granite to open cracks forming parallel with the direction of maximum compression.—D.B.V.

8792 **Brace, W. R.; Byerlee, J. D.** Stick-slip as a mechanism for earthquakes: Science, v. 153, no. 3739, p. 990–992, illus., 1966.

Stick-slip often accompanies frictional sliding in laboratory experiments with geologic materials. Shallow-focus earthquakes may represent stick-slip during sliding along old or newly formed faults in the earth. In such a situation, observed stress drops represent release of a small fraction of the stress supported by the rock surrounding the earthquake focus.—Authors' abstract

Bradbury, J. P. *See* Kirkland, D. W. 8550

8442 **Brady, Arthur Gerald.** Studies of reponse to earthquake ground motion [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 808B, 1966.

Brady, G. A. *See* Baker, A. F. 8400

8370 **Brawner, C. O.** Slope stability in open-pit mines: Western Miner, v. 39, no. 10, p. 56–72, 1966.

Application of rock mechanics results in substantial savings by allowing steepening of slopes under some conditions. Evaluation of stability is based partly on principles of soil mechanics and partly on empirical evaluation of tectonic rock defects. Methods of evaluation are described.—A.R.K.

8896 **Bredehoeft, John D.; Cooper, Hilton H., Jr.; Papadopulos, Istavros S.** Inertial and storage effects in well-aquifer systems—An analog investigation: Water Resources Research, v. 2, no. 4, p. 697–707, illus., tables, 1966.

Equations for nonsteady ground-water flow, based on Darcy's law, assume negligible forces of inertia in the aquifer and infinitesimal diameter of the pumping well, neglecting additional well storage. For problems involving rapid acceleration of the water, the inertial forces and/or well storage may be significant in both aquifer and well, as results of investigation by electric analog indicate. Critical damping curves for 6-inch-diameter wells are presented. Except where changes in velocity occur very rapidly, inertial effects in the aquifer are negligible when compared with frictional losses.—G.D.C.

Brigger, A. L. *See* Hanna, G. Dallas. 8816

8488 **Briggs, Garrett.** Primary sedimentary structures in search for petroleum [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2325–2326, 1966.

8429 **Brod, Lang.** St. Louis County caves: Missouri Speleology, v. 8, no. 1, p. 3–50, illus., 1966.

The number of known caves in St. Louis County exceeds 40. The three distinct speleological provinces include the fissure cave group and the northern and southern St. Louis County sinkhole plains. The northern plain lies at a lower altitude than the southern, and cave development is more limited. Twenty-one cave descriptions are given.—E.S.L.

8461 **Brooker, Edward James.** The interpretation of the reciprocal lattice in randomly oriented single crystals [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 856B, 1966.

8357 **Bryant, Bruce.** Formation of phyllonites in the Grandfather Mountain area, northwestern North Carolina, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D144–D150, illus., tables, 1966.

Field relations, petrographic data, and limited chemical data show that phyllonites derived by Paleozoic lowgrade metamorphism of Precambrian granitic rocks and gneisses formed in chemical systems generally open to K, Na, Ca, and H and locally open to a number of other components. Hydrolysis of feldspars was the principal reaction affecting the alkali content of the phyllonites. Changes in chemical and mineral composition of the rock in the phyllonite zones were probably controlled through a combination of intense shearing and type and availability of solution.—Author's abstract

Bryant, William R. *See* Morelock, Jack. 8469

Burchfiel, B. C. *See* Stewart, John H. 8341

Burckle, Lloyd H. *See* Saito, Tsunemasa. 8795

8460 **Burger, John Allan.** Mesaverde group in adjoining areas of Utah, Colorado and Wyoming [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 856B–857B, 1966.

Burk, C. A. *See* Nelson, T. W. 8364

8371 **Burkart, Burke.** (compiler). Mapa geológico de Guatemala—Cerro Montecristo (Hoja'2359 III G): Guatemala City, Guatemala Inst. Geográfico Nacional, scale 1:50,000, 1966.

8372 **Burkart, Burke.** (compiler). Mapa geológico de Guatemala—Esquipulas (Hoja 2359 IV G): Guatemala City, Guatemala Inst. Geográfico Nacional, scale 1:50,000, 1966.

Burridge, R. *See* Knopoff, L. 8390

8732 **Busch, W. L.** Mineral production in Illinois in 1965 and summary of Illinois mineral production by commodities, 1941–1965: Illinois Geol. Survey Circ. 407, 26 p., illus., tables, 1966.

The value of minerals produced in Illinois in 1965 totaled 618.5 million dollars. This was the second highest annual value ever recorded for mineral production in the state. Illinois minerals include coal, oil, stone, sand and gravel, fluorspar, lead, zinc, and other items such as clay products, cement, and lime. The annual value of the minerals has been over 600 million dollars for each year, 1956–1965. The quantity and value of minerals produced in 1965 are summarized in the tables and maps of this report.—Author's abstract

Byerlee, J. D. *See* Brace, W. R. 8792

Byrne, Robert J. *See* Miller, Robert L. 8449

8818 **Cameron, R. E.** Properties of desert soils, Chap. 8 *in* Biology and the exploration of Mars: Natl. Acad. Sci.—Natl. Research Council Pub. 1296, p. 164–186, illus., tables, 1966.

In desert areas there is a noticeable dearth of organisms; consequently they have little or no influence in the formation of true desert soils. Results from recent studies in the Great Basin, Mohave, and Colorado Deserts may illuminate the problems of sampling and detecting life; additional information comes from volcanic deserts of Hawaii, the Valley of 10,000 Smokes in Alaska, and high altitude areas in the White Mountains of California. Profile figures illustrate the various physical properties of the soils and related distribution of microorganisms; the latter is summarized in tables. Surface crusts are described which are very important microenvironments.—G.D.C.

Camp, L. R. *See* Ehrlinger, H. P., 3d. 8501

8386 **Campbell, Neil.** The lead–zinc deposits of Pine Point: Canadian Mining and Metall. Bull., v. 59, no. 652, p. 953–960, 1966.

After tracing the history of exploration and development work at Pine Point, this paper illustrates the practical application of geology and geophysics to the finding of the lead zinc type of ore deposit. The author's current views on ore genesis are outlined. He attributes the source of lead, zinc, and iron to magmatic fluids rising to the permeable dolomitized reef and to a lesser extent elsewhere, with formation of sulphides in the petroliferous, and in part sulphur-bearing, reducing environment of parts of the Devonian sediments. Reserves of 21.5 million tons, averaging 4 percent lead and 7.2 percent zinc, were reported in 1965.—Author's abstract

8581 **Canada Geological Survey.** Aeromagnetic map, Willow Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3334, scale 1:63,360, 1966.

8582 **Canada Geological Survey.** Aeromagnetic map, Stewart Crossing, Yukon Territory: Canada Geol. Survey Geophysics Paper 3335, scale 1:63,360, 1966.

8583 **Canada Geological Survey.** Aeromagnetic map, Moose Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 3336, scale 1:63,360, 1966.

8584 **Canada Geological Survey.** Aeromagnetic map, Sprague Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 3337, scale 1:63,360, 1966.

8585 **Canada Geological Survey.** Aeromagnetic map, Larsen Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 3338, scale 1:63,360, 1966.

8586 **Canada Geological Survey.** Aeromagnetic map, Davidson Pass, Yukon Territory: Canada Geol. Survey Geophysics Paper 3339, scale 1:63,360, 1966.

8587 **Canada Geological Survey.** Aeromagnetic map, Ark Mountain, Yukon Territory: Canada Geol. Survey Geophysics Paper 3340, scale 1:63,360, 1966.

8588 **Canada Geological Survey.** Aeromagnetic map, Sandpiper Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 3341, scale 1:63,360, 1966.

8589 **Canada Geological Survey.** Aeromagnetic map, Jo-Jo Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3342, scale 1:63,360, 1966.

8590 **Canada Geological Survey.** Aeromagnetic map, Champagne, Yukon Territory: Canada Geol. Survey Geophysics Paper 3343, scale 1:63,360, 1966.

8591 **Canada Geological Survey.** Aeromagnetic map, Mount Cooper, Yukon Territory: Canada Geol. Survey Geophysics Paper 3344, scale 1:63,360, 1966.

8592 **Canada Geological Survey.** Aeromagnetic map, Vowel Mountain, Yukon Territory: Canada Geol. Survey Geophysics Paper 3345, scale 1:63,360, 1966.

8593 **Canada Geological Survey.** Aeromagnetic map, Kirkland Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 3346, scale 1:63,360, 1966.

8594 **Canada Geological Survey.** Aeromagnetic map, Mount Morrison, Yukon Territory: Canada Geol. Survey Geophysics Paper 3347, scale 1:63,360, 1966.

8595 **Canada Geological Survey.** Aeromagnetic map, Summit Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3352, scale 1:63,360, 1966.

8596 **Canada Geological Survey.** Aeromagnetic map, Ethel Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3353, scale 1:63,360, 1966.

8597 **Canada Geological Survey.** Aeromagnetic map, Minto Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3354, scale 1:63,360, 1966.

8598 **Canada Geological Survey.** Aeromagnetic map, Seattle Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 3355, scale 1:63,360, 1966.

8599 **Canada Geological Survey.** Aeromagnetic map, North McQuesten River, Yukon Territory: Canada Geol. Survey Geophysics Paper 3356, scale 1:63,360, 1966.

8600 **Canada Geological Survey.** Aeromagnetic map, Worm Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3357, scale 1:63,360, 1966.

8601 **Canada Geological Survey.** Aeromagnetic map, Primrose Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3358, scale 1:63,360, 1966.

8602 **Canada Geological Survey.** Aeromagnetic map, Rose Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3359, scale 1:63,360, 1966.

8603 **Canada Geological Survey.** Aeromagnetic map, Mount Arkell, Yukon Territory: Canada Geol. Survey Geophysics Paper 3360, scale 1:63,360, 1966.

8604 **Canada Geological Survey.** Aeromagnetic map, Takhini River, Yukon Territory: Canada Geol. Survey Geophysics Paper 3361, scale 1:63,360, 1966.

8605 **Canada Geological Survey.** Aeromagnetic map, Pilot Mountain, Yukon Territory: Canada Geol. Survey Geophysics Paper 3362, scale 1:63,360, 1966.

8606 **Canada Geological Survey.** Aeromagnetic map, Braeburn Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3363, scale 1:63,360, 1966.

8607 **Canada Geological Survey.** Aeromagnetic map, Twin Lakes, Yukon Territory: Canada Geol. Survey Geophysics Paper 3364, scale 1:63,360, 1966.

8608 **Canada Geological Survey.** Aeromagnetic map, Mandanna Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3365, scale 1:63,360, 1966.

8609 **Canada Geological Survey.** Aeromagnetic map, Mayo, Yukon Territory: Canada Geol. Survey Geophysics Paper 3370, scale 1:63,360, 1966.

8610 **Canada Geological Survey.** Aeromagnetic map, Mount Haldane, Yukon Territory: Canada Geol. Survey Geophysics Paper 3371, scale 1:63,360, 1966.

8611 **Canada Geological Survey.** Aeromagnetic map, Dublin Gulch, Yukon Territory: Canada Geol. Survey Geophysics Paper 3372, scale 1:63,360, 1966.

8612 **Canada Geological Survey.** Aeromagnetic map, Elliot Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3373, scale 1:63,360, 1966.

8613 **Canada Geological Survey.** Aeromagnetic map, Wheaton River, Yukon Territory: Canada Geol. Survey Geophysics Paper 3374, scale 1:63,360, 1966.

8614 **Canada Geological Survey.** Aeromagnetic map, Alligator Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3375, scale 1:63,360, 1966.

8615 **Canada Geological Survey.** Aeromagnetic map, Whitehorse, Yukon Territory: Canada Geol. Survey Geophysics Paper 3376, scale 1:63,360, 1966.

8616 **Canada Geological Survey.** Aeromagnetic map, Upper Laberge, Yukon Territory: Canada Geol. Survey Geophysics Paper 3377, scale 1:63,360, 1966.

8617 **Canada Geological Survey.** Aeromagnetic map, Lake Laberge, Yukon Territory: Canada Geol. Survey Geophysics Paper 3378, scale 1:63,360, 1966.

8618 **Canada Geological Survey.** Aeromagnetic map, Lower Laberge, Yukon Territory: Canada Geol. Survey Geophysics Paper 3379, scale 1:63,360, 1966.

8619 **Canada Geological Survey.** Aeromagnetic map, Frank Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 3380, scale 1:63,360, 1966.

8620 **Canada Geological Survey.** Aeromagnetic map, Claire Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3381, scale 1:63,360, 1966.

8621 **Canada Geological Survey.** Aeromagnetic map, Keno Hill, Yukon Territory: Canada Geol. Survey Geophysics Paper 3386, scale 1:63,360, 1966.

8622 **Canada Geological Survey.** Aeromagnetic map, McQuesten Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3387, scale 1:63,360, 1966.

8623 **Canada Geological Survey.** Aeromagnetic map, Horseshoe Hill, Yukon Territory: Canada Geol. Survey Geophysics Paper 3388, scale 1:63,360, 1966.

8624 **Canada Geological Survey.** Aeromagnetic map, Mayo Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3393, scale 1:63,360, 1966.

8625 **Canada Geological Survey.** Aeromagnetic map, Scoudale Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 3394, scale 1:63,360, 1966.

8626 **Canada Geological Survey.** Aeromagnetic map, Mount Williams, Yukon Territory: Canada Geol. Survey Geophysics Paper 3395, scale 1:63,360, 1966.

8627 **Canada Geological Survey.** Aeromagnetic map, Mount Westman, Yukon Territory: Canada Geol. Survey Geophysics Paper 3400, scale 1:63,360, 1966.

8628 **Canada Geological Survey.** Aeromagnetic map, Mount Good, Yukon Territory: Canada Geol. Survey Geophysics Paper 3401, scale 1:63,360, 1966.

8629 **Canada Geological Survey.** Aeromagnetic map, Eates River, Yukon Territory: Canada Geol. Survey Geophysics Paper 3402, scale 1:63,360, 1966.

8630 **Canada Geological Survey.** Aeromagnetic map, Cottonwood Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 3403, scale 1:63,360, 1966.

8631 **Canada Geological Survey.** Aeromagnetic map, Profile Mountain, Yukon Territory: Canada Geol. Survey Geophysics Paper 3404, scale 1:63,360, 1966.

8632 **Canada Geological Survey.** Aeromagnetic map, Dalton Post, Yukon Territory: Canada Geol. Survey Geophysics Paper 3405, scale 1:63,360, 1966.

8633 **Canada Geological Survey.** Aeromagnetic map, Mush Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3406, scale 1:63,360, 1966.

8634 **Canada Geological Survey.** Aeromagnetic map, Oasis Lake, Manitoba–Ontario: Canada Geol. Survey Geophysics Paper 4021, scale 1:63,360, 1966.

8635 **Canada Geological Survey.** Aeromagnetic map, Benson Bay, Manitoba–Ontario: Canada Geol. Survey Geophysics Paper 4022, scale 1:63,360, 1966.

8636 **Canada Geological Survey.** Aeromagnetic map, Minago Creek, Manitoba: Canada Geol. Survey Geophysics Paper 4099, scale 1:63,360, 1966.

8637 **Canada Geological Survey.** Aeromagnetic map, Sheet 62 P/16, Manitoba: Canada Geol. Survey Geophysics Paper 4100, scale 1:63,360, 1966.

8638 **Canada Geological Survey.** Aeromagnetic map, White Beaver River, Manitoba: Canada Geol. Survey Geophysics Paper 4101, scale 1:63,360, 1966.

8639 **Canada Geological Survey.** Aeromagnetic map, Boulder Rapids, Manitoba: Canada Geol. Survey Geophysics Paper 4102, scale 1:63,360, 1966.

8640 **Canada Geological Survey.** Aeromagnetic map, Wrong Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4103, scale 1:63,360, 1966.

8641 **Canada Geological Survey.** Aeromagnetic map, Sheet 63 A/16, Manitoba: Canada Geol. Survey Geophysics Paper 4104, scale 1:63,360, 1966.

8642 **Canada Geological Survey.** Aeromagnetic map, Sheet 63 H/1, Manitoba: Canada Geol. Survey Geophysics Paper 4105, scale 1:63,360, 1966.

8643 **Canada Geological Survey.** Aeromagnetic map, Bennett Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4106, scale 1:63,360, 1966.

8644 **Canada Geological Survey.** Aeromagnetic map, Gunisao Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4107, scale 1:63,360, 1966.

8645 **Canada Geological Survey.** Aeromagnetic map, Pelican Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4108, scale 1:63,360, 1966.

8646 **Canada Geological Survey.** Aeromagnetic map, Sheet 63 I/1, Manitoba: Canada Geol. Survey Geophysics Paper 4109, scale 1:63,360, 1966.

8647 **Canada Geological Survey.** Aeromagnetic map, Robinson Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4110, scale 1:63,360, 1966.

8648 **Canada Geological Survey.** Aeromagnetic map, Porcupine Hill Creek, Manitoba. Canada Geol. Survey Geophysics Paper 4111, scale 1:63,360, 1966.

8649 **Canada Geological Survey.** Aeromagnetic map, Sheet 63 I/16, Manitoba: Canada Geol. Survey Geophysics Paper 4112, scale 1:63,360, 1966.

8650 **Canada Geological Survey.** Aeromagnetic map, Dezadeash, Yukon Territory: Canada Geol. Survey Geophysics Paper 7207, scale 1:253,440, 1966.

8651 **Canada Geological Survey.** Aeromagnetic map, Aishihik Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 7208, scale 1:253,440, 1966.

8652 **Canada Geological Survey.** Aeromagnetic map, Glenlyon, Yukon Territory: Canada Geol. Survey Geophysics Paper 7209, scale 1:253,440, 1966.

8653 **Canada Geological Survey.** Aeromagnetic map, Carmacks, Yukon Territory: Canada Geol. Survey Geophysics Paper 7210, scale 1:253,440, 1966.

8654 **Canada Geological Survey.** Aeromagnetic map, McQuesten, Yukon Territory: Canada Geol. Survey Geophysics Paper 7212, scale 1:253,440, 1966.

8655 **Canada Geological Survey.** Aeromagnetic map, Nash Creek, Yukon Territory. Canada Geol. Survey Geophysics Paper 7213, scale 1:253,440, 1966.

8656 **Canada Geological Survey.** Aeromagnetic map, Larsen Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 7214, scale 1:253,440, 1966.

8402 **Cannaday, F. X.; Leo, G. M.** Piezoelectric pulsing equipment for sonic velocity measurements in rock samples from laboratory size to mine pillars: U.S. Bur. Mines Rept. Inv. 6810, 23 p., illus., tables, 1966.

Pulses are produced by electronically excited piezoelectric ceramic transducers. Special equipment components were developed by Bureau facilities; other components are commercially available. The technique permits a non-destructive, repetitive, stable, shaped pulse to be used in place of explosive caps or hammer blows. Longitudinal wave traveltime measurements are taken on an oscilloscope screen; transverse wave measurements are taken under special field conditions. Results are consistently repeatable within the accuracy of the oscilloscopes utilized.—H.R.B.

8868 **Carder, D. S.** Earthquake prediction, past, present, and possibilities for the future [abs.], *in* World Conf. Earthquake Eng., 3d, New Zealand, 1965, Proc., V. 1: Wellington, New Zealand Inst. Engineers, p. III-251, 1965 [1966].

8702 **Carlston, Charles W.** The effect of climate on drainage density and streamflow: Internat. Assoc. Sci. Hydrology Bull., v. 11, no. 3, p. 62–69, illus., table, 1966.

Climatic differences in rainfall intensity between humid subtropic southeastern United States and marine west coast regions affect runoff and drainage density values on areas of similar bedrock. However, terrane transmissibility may vary because temperature differences affect character of the soil cover. In the High Plains of semi-arid eastern Colorado, caprock of partly indurated sand and gravel permits the relatively small precipitation to penetrate deep enough to support a grass cover which enhances infiltration and resists channel growth. In the Badlands of South Dakota, clay rock rejects the slightly less rainfall, so there is no protective vegetal cover and a far wider range of drainage density. In desert regions evapotranspiration added to decrease in rainfall results in high drainage density on most rock types but less intricate dissection than in semi-arid regions.—G.D.C.

8803 **Carr, Donald C.; Horowitz, Alan; Hrabar, S. V.; Ridge, Kathleen F.; Rooney, Rosalia; Straw, W. Thomas; Webb, William; Potter, Paul Edwin.** Stratigraphic sections, bedding sequences, and random processes: Science, v. 154, no. 3753, p. 1162–1164, illus., 1966.

Both dependent and independent random processes can be used to study and synthesize stratigraphic sections and bedding sequences. Synthetic stratigraphic sections can be modeled to fit any geologic problem with a good correspondence between the synthetic and actual stratigraphic sections. To synthesize a sedimentary sequence, one needs only a transition procedure to go from one lithology or bedding type to another, and frequency distributions of thickness for the various lithologies. A sedimentation process with a "memory" is termed Markovian; if the past has no influence on either present or future sedimentation, it is called an independent trials process.—Authors' abstract

8356 **Carroll, Roderick D.; Scott, James H.** Uphole seismic measurements as an indication of stress relief in granitic rock tunnels, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D138-D143, illus., table, 1966.

Seismic velocities obtained in holes drilled into the walls of a tunnel in granitic rock show the presence of a low-velocity zone ranging in thickness from 0 to 8 feet. The low-velocity zone is attributed to the effects of movement of rock into the tunnel. The detection, thickness, and velocity of the zone appear related to the presence of fractures rather than to the size of the tunnel. The seismic velocities measured in this environment appear related to rock competence rather than to the thickness of the low-velocity layer. Research into the quantitative relationship of the velocity differences to actual stress distribution around a tunnel opening is required.—Authors' abstract

8759 **Cedergren, Harry R.** A method for earthquake resistance design of earth dams—Discussion [of paper 4616 by H. B. Seed, 1966]: Am. Soc. Civil Engineers Proc., v. 92, paper 4890, Jour. Soil Mechanics and Found. Div., no. SM 5, p. 140-141, 1966.

Seed has presented a rational approach to a difficult problem. Little is known of the true behavior of earth masses during earthquakes. Much evidence suggests that nearly all significant damage may be caused by shaking, rather than by the primary forces. Thorough compaction, good drainage, elimination of weak materials from foundations, and use of strong materials in embankment zones should be required in all important dams.—E.S.L.

8883 **Chapman, L. J.; Putnam, D. F.** The physiography of southern Ontario (2d edition): Toronto, Ontario, Univ. Toronto Press (for Ontario Research Found.), 386 p., illus., revised 1966; originally published 1951.

The second edition contains some changes and additions in light of studies made since 1950; interpretations of glacial history have been altered at some stages and more information is available on the composition of glacial deposits. The major features of southern Ontario are controlled by bedrock structures, especially the local landforms composed of unconsolidated materials. Four large maps showing classification and distribution of landforms accompany the report, and are not changed from the first edition, but a generalized smaller map has been added. Fifty-two minor physiographic regions and types of surface features, mostly glacial, are described. The glacial geology from pre-Wisconsin beds to post-glacial developments is examined from a geomorphological rather than stratigraphic point of view.—E.S.L.

8767 **Charlier, Roger H.** Growth of oceanographic education in the United States: Limnology and Oceanography, v. 11, no. 4, p. 636-640, tables, 1966.

Data gathered over the last three years disclose a considerable upward trend in oceanographic interest and an expansion of new courses and programs, especially on the undergraduate level. A list of schools offering an undergraduate major or an advanced degree in oceanography is given.—E.S.L.

Chase, Livingston. *See* McKelvey, V. E. 8365

8523 **Chen, T. S.; Marovelli, R. L.** Analysis of stresses in a rock disk subjected to peripheral thermal shock: U.S. Bur. Mines Rept. Inv. 6823, 50 p., illus., table, 1966.

The authors present a theoretical analysis based on one-dimensional radial heat flow by conduction in a rock disk, and on heat exchange by convection between the disk and its surroundings. Preliminary experimental data obtained from shock tests on thin circular disks of basalt, quartzite, and taconite show reasonably good agreement with theory. Solutions of the stress distribution are presented for both cooling and heating shocks. The elastic energy stored at fracture is examined, and on this basis an average stress theory is formulated. Physical properties vital to the studies include thermal conductivity, thermal diffusivity, tensile strength, Young's modulus, and linear coefficient of thermal expansion. This work is of importance in predicting the thermal shock response of a rock body of finite size.—H.R.B.

8407 **Chittenden, David Morse, 2d.** Noble gases in granites and accessory minerals [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 709B, 1966.

Christiansen, Robert L. *See* Lipman, P. W. 8796

8708 **Churkin, Michael, Jr.** Morphology and stratigraphic range of the phyllocarid crustacean *Caryocaris* from Alaska and the Great Basin: Palaeontology, v. 9, pt. 3, p. 371–380, illus., 1966.

Exceptionally well-preserved specimens of *Caryocaris* from Alaska and the Great Basin show a peculiar shell enrollment; several other important skeletal details are described for the first time. In the light of this new material, Ruedemann's types that are the basis for his reconstruction of *Caryocaris* are re-examined. Finally, a review of the stratigraphic range of *Caryocaris* leads to the conclusion that none of its reported Silurian species are definitely *Caryocaris*. The range of the genus should therefore be restricted for the present to the Ordovician and probably to the lower half of the system.—Author's abstract

Clark, Thomas H. *See* Wiesnet, Donald R. 8342

8448 **Clayton, R. N.; Friedman, I.; Graf, D. L.; Mayeda, T. K.; Meents, W. F.; Shimp, N. F.** The origin of saline formation waters—[Pt.] 1, Isotopic composition: Jour. Geophys. Research, v. 71, no. 16, p. 3869–3882, illus., table, 1966.

The content of total dissolved solids and δD and δO^{18} values are given for 95 oil-field brines from the Illinois, Michigan, and Alberta basins and the Gulf Coast. The variation in deuterium content among basins is found to be much greater than that within each basin. Oxygen isotopic composition, on the other hand, shows a large range in each basin, strongly correlated with salinity. The relationships between isotopic and chemical compositions of the brines lead to the following conclusions: (1) the water is predominantly of local meteoric origin; (2) the deuterium content has not been greatly altered by exchange or fractionation processes; (3) extensive oxygen exchange has taken place between water and reservoir rocks. Several samples contain water which appears to have originated as precipitation during Pleistocene glacial periods.—Authors' abstract

8725 **Cloke, Paul L.** The geochemical application of Eh-pH diagrams: Jour. Geol. Education, v. 14, no. 4, p. 140–148, illus., 1966.

Procedures for constructing Eh-pH diagrams are presented. In the application of these diagrams, it is pointed out how different environments correspond to different parts of the diagram, which indicates that iron, in particular, and other elements, in general, should have different chemical behavior in each environment. The correspondence of the behavior expected from these chemical considerations and the actual behavior in nature shows that these diagrams are useful in understanding natural processes.—*from* Author's summary

8809 **Cloud, Preston E., Jr.** Bauxite deposits of the Anniston, Fort Payne, and Ashville areas, northeast Alabama: U.S. Geol. Survey Bull. 1199-O, p. O1–O35, illus., geol. map, 1966.

Bauxite occurs with kaolin in two deposits in the Anniston area, three in the Fort Payne area, and one in the Ashville area. Kaolin deposits without associated bauxite

also occur sparingly. Bauxite was mined in the Fort Payne area in 1917–18 and in the Ashville area in 1941–42. Total production amounted to 1,100 tons. Kaolin has been mined intermittently since the early 1900's. Bauxite, kaolin, and associated unconsolidated sediments appear to fill sinklike depressions in underlying carbonate rocks of early Paleozoic age. A fossil flora, probably of early Tertiary age, was collected from lignite in unconsolidated sediments in the Anniston and Fort Payne areas.—A.C.S.

Cloud, W. K. *See* Algermissen, S. T. 8565

Clough, R. W. *See* Jenschke, V. A. 8862

8452 **Coatney, Richard Lee.** Modal analysis of the granitic rocks of the northern Sierra Nevada between Yosemite and Lake Tahoe, California [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 898B–899B, 1966.

Cobban, William A. *See* Gill, James R. 8740

8849 **Cohen, Philip; Durfor, C. N.** Design and construction of a unique injection well on Long Island, New York, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D253–D257, illus., table, 1966.

An injection well of unique design and construction recently completed on Long Island, N. Y., will be used in making a series of artificial-recharge experiments with highly treated sewage-plant effluent. The well, about 500 feet deep, consists of two adjacent fiberglass casings (18 inches and 4 inches in diameter) and 7 auxiliary pipes, 4 of which are made of fiberglass and 3 of polyvinyl chloride. Fiberglass was used because of its advantageous chemical and strength characteristics. A stainless-steel well screen, 62 feet long, is attached to the bottom end of each casing. Water will be injected into the aquifer through the large casing and screen, and hydraulic-head changes will be measured at several points within the well and filterpack. Geochemical reactions related to the head changes will be monitored by means of instruments in each screen.—Authors' abstract

8466 **Coleman, J. M.** Ecological changes in massive fresh-water clay sequence [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2321, 1966.

Conway, K. C. *See* Adami, L. H. 8522

Cooper, Hilton H., Jr. *See* Bredehoeft, John D. 8896

Copley, Albert J. *See* Faruqi, Shamim A. 8784

8709 **Cornish, Earl C.** Sampling ore deposits: Colorado School Mines Mineral Industries Bull., v. 9, no. 2, 14 p., illus., tables, 1966.

Incorrect interpretation of "representative sample" is the chief cause of the problem of incorrect sampling procedure and interpretation. Two important points in defining the phrase are, that the sample is small compared to the mass and that the quality of the thing represented can only be inferred from the sample. In order to determine the number of sufficient initial samples, a brief and simplified account is given of some of the theory on which sampling is based. Surface and underground sampling procedures are discussed, with test pits, trenches, and drilling (diamond and churn) under the former, and channel and grab samples under the latter. After the sample is taken, reduction to assay size follows a definite procedure; the important thing is that the bulk should not be reduced more rapidly than the size.—E.S.L.

8718 **Cotet, Petre V.** La géomorphologie et ses subdivisions—Quelques considérations générales: Cahiers Géographie Québec, v. 10, no. 19, p. 101–106, 1966.

The name used most commonly now for the science of relief is geomorphology. Some of the definitions are discussed, especially the relation of morphology and geomorphology, and the science is subdivided into descriptive, genetic, and historical geomorphology. Evolution of relief, ascendant and descendant phases, reflects the

relation between action of internal and external forces. Geomorphology should be considered as a separate science, developing in contact with geology and geography.—E.S.L.

Couch, R. W. *See* Dehlinger, P. 8554

8686 **Crain, Leslie J.** Ground-water resources of the Jamestown area, New York—With emphasis on the hydrology of the major stream valleys: New York Water Resources Comm. Bull. 58, 167 p., illus., tables, geol. maps, 1966.

All of the Jamestown area except the extreme southeastern corner has been glaciated, and extensive deposits fill the three large valleys to thicknesses of more than 600 feet in places. Sand and gravel in these valleys or deltas of tributary streams are the most productive water-bearing deposits. The Jamestown aquifer, the most important, is a sand and gravel deposit about 20 feet thick underlying Cassadaga Creek valley and connecting hydraulically to the lower part of several deltas. The city of Jamestown, in 1965, pumped about 6 mgd from a well field in this aquifer. Another important aquifer underlies the Conewango Creek valley near Poland Center, and may have a potential yield of a few million gallons a day. Graphic well logs are included, and records of selected wells and test holes are tabulated.—E.S.L.

8573 **Crandell, D. R.** Volcanic hazards at Mount Rainier, Washington [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Div. Mtg. Solid Earth Physics II, p. 31, 1966.

8373 **Crane, David C.** (compiler). Mapa geológico de Guatemala—Jocotán (Hoja 2360 III G): Guatemala City, Guatemala Inst. Geográfico Nacional, scale 1:50,000, 1966.

Creath, Wilgus B. *See* Thompson, Robert R. 8749

Cropper, A. G. *See* Belshé, J. C. 8569

8413 **Crozaz, G.; Langway, C. C., Jr.** Dating Greenland firn-ice cores with Pb-210: Earth and Planetary Sci. Letters, v. 1, no. 4, p. 194-196, illus., tables, 1966.

The Pb-210 dating method is applied to deep thermally recovered firn-ice cores from the North Greenland ice sheet. The Pb-210 activity is found to decay exponentially with depth (expressed in water equivalent). The corresponding rate of snow accumulation, averaged over the past 150 years, is (32 ± 3) g/cm^2-yr, in good agreement with present day surface snow accumulation obtained by different methods.—Authors' abstract

Cumming, G. L. *See* Folinsbee, R. E. 8657

Davenport, A. G. *See* Milne, W. G. 8866

8799 **Davidson, D. M., Jr.; Kerr, P. F.** Uranium deposits at Kane Creek, Utah: Soc. Mining Engineers Trans., v. 235, no. 2, p. 127-132, illus., tables, 1966.

Uranium at Kane Creek, southwest of Moab, occurs in the Permian Cutler Formation in fissure-type vertical veins, as well as the usual sedimentary deposits in the Chinle. A general stratigraphic section is given. Bleaching in the adjacent Cutler is related to faulting and post-depositional activity. Argillic alteration appears related to ore emplacement, and the Cutler deposits are classified as telethermal. Isotopic age of vein uraninites is consistent with Laramide mineralization.—E.S.L.

8543 **Davis, G. H.** Frequency distribution of dissolved solids in ground water: Ground Water, v. 4, no. 4, p. 5-12, illus., table, 1966.

Frequency distribution of dissolved solids in waters from geologically and climatologically homogeneous terrane units commonly approximates a lognormal distribution. All published water analyses identified as to geologic source from 11 terranes within the Potomac and San Joaquin River basins and Salt Lake basin

are used in the studies. A graphic method for a logarithmic transformation in which dissolved-solids content is plotted against percent frequency permits calculation of approximate values of the mean, standard deviation, and coefficient of variation without extensive computations. Statistical parameters of central tendency and dispersion calculated this way agree with the known physical conditions in the terranes studied.—E.S.L.

Davis, John C. *See* Sampson, Robert J. 8426

8679 **Davis, John C.; Sampson, Robert J.** FORTRAN II program for multivariate discriminant analysis using an IBM 1620 computer: Kansas Geol. Survey Computer Contr. 4, 8 p., 1966.

Matrix inversion is avoided by using a procedure in which samples are operated upon one at a time. The program has been tested using data published on paleontological measurements and sediment studies. A program listing for discriminate analysis of two populations, using up to 20 variables and an unlimited number of samples is given.—E.S.L.

8720 **Davis, Lawrence L.** Project Palanquin—Analysis of surface seismic data: U.S. Atomic Energy Comm. Rept. PNE-913F, 56 p., illus., tables, 1966.

Recorded peak values of ground motion from Palanquin, a nuclear event in rhyolite at Pahute Mesa, Nev., are presented in tabular and graphic form; where appropriate, least-squares regression equations were fitted to the data. Comparisons of observed with predicted data show that predictions were higher than observed acceleration and velocity but lower than observed displacement. Differences were small and prediction equations are considered adequate.—V.S.N.

8534 **Davis, Richard A., Jr.** Willow River Dolomite—Ordovician analogue of modern algal stromatolite environments: Jour. Geology, v. 74, no. 6, p. 908-923, illus., 1966.

The Willow River Dolomite Member of the Shakopee Formation (Lower Ordovician) in the Upper Mississippi Valley is mainly dolomite and quartzitic dolomite with minor amounts of quartz sandstone, shale, and chert. Algal stromatolites are the only common organic remains. The sediments were deposited in a shallow, epeiric sea of three broad environments: (1) open marine area in the northwest, with grain sparite, abundant oölite, and abundant fossils; (2) intertidal high energy zone in the central area, with abundant stromatolitic algal biolithite and associated intrasparite; and (3) locally intertidal and hypersaline low energy zone in the southeast, with micrite, algal mats, and desiccation features. Terrigenous materials were derived from Precambrian and Cambrian rocks to the northeast.—*from* Author's abstract

Dean, W. E., Jr. *See* Kirkland, D. W. 8550

8735 **DeCarlo, J. A.; Sheridan, E. T.; Murphy, Z. E.** Sulfur content of United States coals: U.S. Bur. Mines Inf. Circ. 8312, 44 p., illus., tables, 1966.

The coals currently produced in the United States are categorized, and the remaining reserves of the various ranks of coal in each state are assessed, according to sulfur content. The influence of sulfur content on coal utilization is discussed, and important coal-producing areas and the coal produced are described.—E.R.L.

8554 **Dehlinger, P.; Couch, R. W.; Gemperle, M.; Rinehart, W. A.** Gravity investigations in the North Pacific Ocean [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Div. Mtg. Solid Earth Physics I, p. 7, 1966.

DeLaney, A. Otis. *See* Englund, Kenneth J. 8344

Denny, Kleber J. *See* Masch, Frank D. 8793

8459 **Derby, James Richard.** Paleontology and stratigraphy of the Nolichucky Formation in southwest Virginia and northeast Tennessee [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 857B, 1966.

Detterman, Robert L. *See* Jones, David L. 8345

8441 **DiBiagio, Elmo Lawrence.** Stresses and displacements around an unbraced rectangular excavation in an elastic medium [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 810B, 1966.

8383 **Dickey, Parke A.** Patterns of chemical composition in deep subsurface waters: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 11, p. 2472–2478, illus., table, 1966.

Stagnant connate waters associated with oil fields are similar in ratios of ions and cations. The principal ion is chloride—nearly always 99 percent. The principal cations are sodium, calcium and magnesium, and the usual Ca/Mg ratio is 5 to 1 (in equivalent weights). The concentration ranges from about 50,000 to 350,000 ppm. There is a general tendency for this type of water to increase in concentration with depth. In artesian situations the compositions of oil field waters is different. They range in concentration from 5,000 to 15,000 ppm. Sodium is the predominant cation, 85 to 100 percent and calcium and magnesium are rare or absent. These waters are classified into two types by their anions: (1) those without SO_4 and HCO_3 from 3 to 85 percent and (2) those with more than 50 percent SO_4.—S.P.S.

8471 **Dickinson, Arthur S.** Paleostructural analysis and application of later structural tilting [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2323, 1966.

8369 **Dickinson, William R.; Lowe, Donald R.** Stratigraphic relations of phosphate- and gypsum-bearing upper Miocene strata, upper Sespe Creek, Ventura County, California: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 11, p. 2464–2470, illus., table, 1966.

Economic gypsum and possibly economic phosphate deposits occur in the marine, upper Miocene, Santa Margarita Formation of upper Sespe Creek. The Oligocene–Miocene section preserved in this area is only 4,000 feet thick whereas to the north and in the Ventura basin equivalent strata are 12,500 feet thick. The paleotectonic setting of the area seems to have been that of a platform between two basins. This type of setting occurs elsewhere in the Coast Range Miocene.—S.P.S.

8418 **Dickson, G. O.; Everitt, C. W. F.; Parry, L. G.; Stacey, F. D.** Origin of thermoremanent magnetization: Earth and Planetary Sci. Letters, v. 1, no. 4, p. 222–224, illus., 1966.

The nature of thermoremanent magnetization in rocks has been the subject of several papers over the past ten years and a satisfying theory is now available which accounts for all reliable observations. It is a straightforward application of conventional ferromagnetic domain theory of Kittel (1949) and others. Verhoogen (1959) supposed that small regions within magnetic grains behaved as single domains; Ozima and Ozima (1965) preferred to assume grain boundaries and thus appealed to anisotropic energy. The relevant magnetic energies are: magnetostatic energy of a single domain region of magnetite; maximum possible magnetocrystalline energy; and maximum possible magnetoelastic strain energy. Recent detailed measurements by Parry (1965) coincide extremely well with the conventional theory. The other two are regarded as physically impossible.—G.D.C.

8753 **Dietrich, R. V.** (compiler). Mineral tables (Hand specimen properties of 1500 minerals): Virginia Polytech. Inst. Bull., v. 59, no. 3 (Eng. Expt. Sta. Ser. 160), 220 p., 1966.

Most of the data upon which these tables are based were taken with permission from System of mineralogy (7th edition), V. 1, 2 and 3 by Dana; Rock forming minerals, V. 1–4 by Deer, Howie, and Zussman; and Elements of optical mineralogy (4th edition), Pt. 2 by Winchell and Winchell. The tables are compiled chiefly for mineral collectors and professional mineralogists, who can distinguish in hand

specimen many more minerals than are included on published determinative tables, and offer no panacea; a few sections may confuse as much as aid. Minerals with metallic lusters are separated from those with nonmetallic lusters to give Tables I and II; in Table III minerals are arranged according to chemical compositions.—G.D.C.

8719 **Dionne, Jean-Claude.** Formes de cryoturbation fossiles dans le sud-est du Québec [with English abs.]: Cahiers Géographie Québec, v. 10, no. 19, p. 89–100, illus., tables, 1966.

Fossil cryoturbation forms in southern Quebec are reported for the first time. About 60 ice wedges were observed in unconsolidated Late Pleistocene and Lower Holocene deposits. Other cryoturbation forms such as injections, standing pebbles and strata deformation are also reported. These forms indicate the existence of a periglacial climate, during the Late Wisconsin, in the Appalachian region of Southeastern Quebec between 12,500 and 10,000 years (B.P.).—Author's English abstract

8850 **Donaldson, Donald E.** Fluorometric analysis of the aluminum ion in natural waters, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D258–D261, tables, 1966.

Aluminum ions combine with Pontachrome Blue Black R (PBBR) at a pH of 4.8 to form a fluorescent complex which serves for quantitative determination of aluminum. The method is sensitive to 0.002 ppm of aluminum. Up to 8 ppm of fluoride can be tolerated. Bathophenanthroline retards the ferrous and ferric ions. The amount of dye necessary to complex the most concentrated aluminum standard was 0.50 mg per 50 ml solution. The Al-PBBR complex reaches full fluorescent development in 65 minutes. The interfering ions in the determination of aluminum by this method are Fe, Ga, Co, UO_2, Cu, Ti, and Ni.—Author's abstract

8508 **Donnay, J. D. H.; Hellner, E.; Niggli, A.** Symbolism for lattice complexes, revised by a Kiel Symposium [with German abs.]: Zeitschr. Kristallographie, v. 123, nos. 3–4, p. 255–262, table, 1966.

The symbols for lattice complexes, as given by C. Hermann, are simplified for easier typing or printing; the "representation" of a lattice complex is introduced as a new concept.—Authors' abstract

8505 **Dosch, M. W.** Pliocene tar sands in Oxnard oil field: California Div. Oil and Gas, California Oil Fields—Summ. Operations 1965, v. 51, no. 2, p. 67–74, illus., 1966.

Quaternary alluvium in Oxnard oil field overlies successively the San Pedro, the Santa Barbara, and the Pico Formations. Tar sands are found at, or near, the base of the Pico (Pliocene) over a good portion of the field; those in the eastern part are the Vaca Tar sands and those in the west, Lower Tar sands. Erratic tar sands occur in the Monterey Formation (Miocene) throughout the field. Structure of the Miocene beds is a homocline dipping about 15° to the northwest; apparent increased dips to the southeast are believed due to faulting. Crude oil from the Vaca sands can be produced more economically than from the Lower sands. M.C.M.

Downs, George R. *See* Beebe, B. W. 8379

Drewes, Harald. *See* Simons, Frank S. 8853

8458 **Drummond, Arthur Darryl.** Mineralogical and chemical study of Craigmont mine, Merritt, British Columbia [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 857B–858B, 1966.

Duennebier, F. K. *See* Johnson, R. H. 8563

8760 **Duncan, J. M.; Seed, H. Bolton.** Strength variation along failure surfaces in clay: Am. Soc. Civil Engineers Proc., v. 92, paper 4971, Jour. Soil Mechanics and Found. Div., no. SM 6, p. 81–104, illus., table, 1966.

Consideration of changes in stress required to cause failure on various planes shows that variation of undrained strength with orientation of failure plane (determined using compression test samples trimmed in various directions) should be similar to in-situ variation of undrained strength. Two types of consolidated-undrained plane strain compression tests were used on samples of undisturbed San Francisco Bay mud. Results show that, depending on orientation of the failure plane, undrained strength may differ by about 30 percent, the value of the strength parameter by 10 percent, the value of the pore pressure parameter by 40 percent, and the strain required to reach failure by a factor of 3. This variation agrees with the form of variation determined by testing undisturbed samples trimmed in various directions.—E.S.L.

Dunrud, C. Richard. *See* Tibbetts, Benton L. 8355

Durfor, C. N. *See* Cohen, Philip. 8849

8841 **Dwornik, Edward J.** Use of the scanning electron microscope in geologic studies, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D209–D213, illus., 1966.

Micrographs of several types of materials show that the advantages of the scanning electron microscope over the optical microscope are greater resolution (presently about 500 A) and great depth of field, which allow direct examination of surface features of irregular objects. The advantages over the transmission electron microscope are greater depth of field and easier sample preparation; however, the resolving power is less than that of the transmission microscope, and electron diffraction is not possible with the scanning type. For those problems in which morphology, microstructure and texture are important, the scanning electron microscope will be a useful tool in conjunction with a transmission electron microscope.—Author's abstract

8750 **Dyck, W.; Lowdon, J. A.; Fyles, J. G.; Blake, W., Jr.** Geological Survey of Canada radiocarbon dates V: Canada Geol. Survey Paper 66-48, 32 p., reprinted 1966.

This paper reports ages determined in the C^{14} Dating Laboratory of the Geological Survey between December, 1964 and November, 1965. It is reprinted directly from "Radiocarbon", v. 8, p. 96–127, 1966.—Authors' abstract

8705 **Eadie, Arthur F.** Blödit-Kristalle von Soda Lake, San Luis Obispo County, Kalifornia [translated from English]: Aufschluss, v. 17, no. 10, p. 268–269, illus., 1966.

The mineral bloedite, a hydrous sodium-magnesium sulfate found in New Mexico and California and other parts of the world, generally occurs between beds of other salts in arid drainage basins and in marine deposits. A unique occurrence of crystals from microscopic size up to 23 cm in length associated with mirabilite, thenardite, and glauberite, is that in Soda Lake, a graben depression close to the San Andreas fault. Production of sodium sulfate, first established in 1912, was renewed in 1963. Bloedite crystals float in concentrated brine in layers of black mud 1.2–1.5 m deep, under a crust of mirabilite 25 cm thick, which in winter protects the underlying brine from rainwater. The bloedite occurs about one-eighth mile offshore; search for crystals is by blind probing.—G.D.C.

Eckert, J. W. *See* Baker, A. F. 8400

8669 **Edwards, Jonathan, Jr.** Coal mining and geology, *in* Appalachia meets the Potomac—Interstate Comm. Potomac River Basin, Spring Mtg., Clarysville, Md., May 1966, Proc.: Washington, D. C., Interstate Comm. Potomac River Basin, p. 6–7, 1966.

The geology of the three Appalachian area counties (Garrett, Allegany, Washington) in western Maryland, is reviewed, with special emphasis on the coal-bearing area of Allegany and Garrett Counties. The coal-bearing strata have been divided into five formations, in which the repetitive sequence of beds is interpreted as due to shoreline shift. Coal was discovered in Georges Creek basin in 1804, and this has remained the most important of the five coal basins.—E.S.L.

8501 **Ehrlinger, H. P., 3d; Mirza, M. B.; Camp, L. R.; Jackman, H. W.** Illinois clays as binders for iron ore pellets—A further study: Illinois Geol. Survey Indus. Minerals Note 28, 14 p., illus., tables, 1966.

Clays from 13 areas in 10 counties of Illinois, from the northern border to the Ohio River and from the east-central area to the Mississippi River, were tested to determine their value as binding agents for the growing iron ore pelletizing industry. Some of the Illinois clays treated with soda ash make binders that show excellent possibilities of being commercially acceptable. Iron ore pellets containing these clays develop green strength and fired strength as high as those of pellets made with the universally accepted western bentonites. Dry strength is not as high as when bentonite is used as a binder, but sufficiently high to be acceptable for most applications.—Authors' abstract

8430 **Eichler, R.; Ristedt, H.** Isotopic evidence on the early life history of *Nautilus pompilius* (Linné): Science, v. 153, no. 3737, p. 734–736, illus., 1966.

The ratios of O-18 to O-16 and of C-13 to C-12 in the early shell and septa of two *Nautilus* specimens are interpreted for the early ontogeny of the animals. Changes in the carbon isotope content are tentatively correlated with the end of the embryonic period and with environmental changes. Variations in the oxygen isotope content are in part ascribed to migrations from warm to cooler water after a certain stage of development. The size of the body chamber of the young animals can be determined by comparison of the isotope contents in outer shell and septa.—Authors' abstract

8415 **Elkins, Thomas A.** Vertical gradient of gravity on axis for hollow and solid cylinders: Geophysics, v. 31, no. 4, p. 816–820, illus., 1966.

The simple case of the vertical gravity gradient on the axis of a hollow cylinder, simulating a borehole, is examined. Formulas for the vertical gradient effect are given for observations above, inside, and below a hollow cylinder and a solid cylinder. The special case of an infinitely large outer radius for the cylinder is also examined, leading to formulas for the vertical gradient effect inside a borehole on its axis and inside a horizontal slab. The influence of the shape of a buried vertical gradient meter on the correction factor for changing the meter reading to density is also considered.—D.B.V.

Ellis, R. M. *See* Jensen, Oliver, 8417

8380 **Ellison, Samuel P., Jr.** Maurice Goldsmith Mehl (1887–1966): Am. Assoc. Petroleum Geologists Bull., v. 50, no. 11, p. 2484, portrait, 1966.

8897 **Elrick, D. E.; Erh, K. T.; Krupp, H. K.** Applications of miscible displacement techniques to soils: Water Resources Research, v. 2, no. 4, p. 717–727, illus., table, 1966.

A new apparatus for studying miscible displacement processes in soils is described. Both the soil water content and the pore water velocity can be controlled within certain ranges. The usefulness of this technique is illustrated by a brief description of: (1) the mixing of Cl^- during miscible displacement in a glass bead medium; (2) the movement and adsorption of Atrazine, a herbicide, in soil; and (3) the movement and microbiological nitrification of NH_4—N to NO_3—N during unsaturated flow conditions in soil.—Authors' abstract

8392 **Emery, C. L.** Rock mechanics in open pit mining: Canadian Mining and Metall. Bull., v. 59, no. 654, p. 1184–1188, 1966.

Rock mechanics can aid in design of open pits. Principal factors affecting rock stresses are geologic conditions, pit geometry, and drainage.—A.R.K.

8367 **Emery, K. O.** Geological methods for locating mineral deposits on the ocean floor, *in* Exploiting the ocean—MTS Conf. and Exhibit, 2d Ann., 1966, Trans.: Washington, D. C., Marine Technology Soc., p. 24–43, illus., table, 1966.

Geological investigations based on modified conventional techniques indicate that, due to lack of deep weathering and erosion of igneous and metamorphic rocks in their few exposures, primary igneous mineral deposits on the ocean floor are unimportant as compared with sedimentary mineral deposits. The chief sedimentary mineral resource, oil and gas, is almost restricted to marine sequences of thick Tertiary strata on most continental shelves. Heavy mineral placer deposits (tin, diamonds, iron, gold) are extensions of those known on land and derived from nearby igneous and metamorphic rocks. Sand and gravel, and cheap shells are more economically produced. The possible exploitation of phosphorite and manganese oxide, abundant as nodules and crusts but in thin blankets, is delayed by their low quality and uncertainties in costs of mining.—G.D.C.

8544 **Emery, P. A.** Use of analog model to predict streamflow depletion, Big and Little Blue River basin, Nebraska: Ground Water, v. 4, no. 4, p. 13–19, illus., tables, 1966.

The U.S. Geological Survey constructed an electric analog model to determine the amount of streamflow depletion by ground water withdrawals upgradient from the Nebraska state line which could be expected to occur in the next 60 years. The model simulates hydraulic conditions in an area of 7,400 sq mi which includes the entire area drained by the Big and Little Blue Rivers in Nebraska. The transmissibility of the aquifer (Pleistocene), based on examination of samples from more than 400 test holes, ranges from less than 1,000 to as much as 300,000 gpd per foot, and the storage coefficient averages about 0.20. Analysis of the model indicates that predicted maximum ground-water withdrawals between 1962 and 2022 will not deplete the base flow of either river by more than five percent.—E.S.L.

Engel, A. E. J. *See* Engel, Celeste G. 8351

8351 **Engel, Celeste G.; Engel, A. E. J.** Volcanic rocks dredged southwest of the Hawaiian Islands, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550–D, p. D104–D108, illus., tables, 1966.

Dredging in a seamount province southwest of the Hawaiian Islands confirms earlier conclusions concerning the association of tholeiitic and alkalic basalts on the ocean floor. Rocks dredged from a small volcano on a major geomorphic, structural, and magnetic lineament which separates contrasting oceanic provinces, consist of tholeiitic basalt related in composition to the Hawaiian tholeiites. Alkali-rich basalt, and other alkalic rocks including hornblende-bearing varieties and a rare biotite trachyte, were dredged from adjacent and nearby large submarine volcanoes south of the lineament. Spatial relations of the rocks in this part of the Pacific Ocean substantiate the hypothesis that in the oceans, volcanic rocks of the alkali series are confined to, and are ideally developed on, large volcanoes.—Authors' abstract

8344 **Englund, Kenneth J.; DeLaney, A. Otis.** Intertonguing relations of the Lee Formation in southwestern Virginia, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550–D, p. D47–D52, illus., 1966.

Upper Mississippian and Lower Pennsylvanian rocks exposed along the margin of the Southwest Virginia coal field include a cliff-forming sequence of quartzose conglomeratic sandstone beds in the Lee Formation. These clean, coarse clastic rocks terminate northeastward by intertonguing and lateral gradation with relatively less quartzose and finer textured sediments of the Pennington, Pocahontas, and New River Formations.—Authors' abstract

8479 **Eppert, Herbert C., Jr.** Stratigraphy of upper Miocene deposits in Sarasota County, Florida [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2322, 1966.

8780 **Erdtmann, Bernd-Dietrich.** *Cymatograptus lauzonensis*, a new graptolite species from the Levis formation, Quebec [with French abs.]: Naturaliste Canadien, v. 93, no. 3, p. 247–251, illus., 1966.

Cymatograptus lauzonensis is a new species and for North America a new genus of graptolite from the siltstones of North Ridge in the town of Lauzon. *Cymatograptus* belongs to the family Sinograptidae, which is well known from Lower Ordovician of northern Europe and China.—Author's abstract

Erh, K. T. *See* Elrick, D. E. 8897

8428 **Euler, Ferdinand.** Device for rapid orientation of crystals by direct-image X-ray technique: U.S. Air Force Cambridge Research Labs. Instrumentation Paper 93 (AFCRL-66-106), 16 p., illus., tables, 1966.

A device has been designed, built, and tested, which facilitates the rapid orientation of crystals by direct inspection of an electronically intensified optical image of their Laué patterns. Remote controls permit the rotation of the sample about two axes during the X-ray exposure. The pattern can also be recorded on fast Polaroid film. The operating characteristics of the device are described.—Author's abstract

Everitt, C. W. F. *See* Dickson, G. O. 8418

Ewing, Maurice. *See* Saito, Tsunemasa. 8795

Fabuss, Bela M. *See* Power, Wilson H. 8412

8726 **Fahnestock, Robert K.** Time-lapse photography for geologic teaching and research: Jour. Geol. Education, v. 14, no. 4, p. 127–130, illus., 1966.

Time-lapse photography is an extremely effective way of presenting many geologic processes in the classroom. Developments in photographic equipment have made it possible to build a wide variety of equipment suitable for photographing and measuring geologic processes. New films, exposure controls and techniques promise better photography under diverse light conditions. Inexpensive apparatus can be designed for 8-mm automatic-exposure motion picture cameras, allowing students and teachers to make their own films.—Author's abstract

8882 **Fairbridge, Rhodes W.** (editor). The encyclopedia of oceanography—Encyclopedia of earth sciences series, V. 1: New York, Reinhold Publishing Corp., 1,021 p., illus., tables, 1966.

This volume contains the first alphabetical treatment of the field of oceanography. The articles cover all aspects of the ocean, abyssal hills, sea water, turbidity currents, and so forth; the geographic and physiographic divisions; and exploration techniques. The 134 contributors are, for the most part, leaders in the various fields.—E.S.L.

8784 **Faruqi, Shamim A.; Copley, Albert J.** A technique for separating pollen and spores from tar: Micropaleontology, v. 12, no. 3, p. 370, 1966.

During investigation of Pleistocene lake deposits of western Oklahoma the authors devised the technique here described for separating pollen and spores from tar. The procedure involves solution of the tar in naptha, flotation of the dissolved tar on acetic acid and methyl alcohol, and decantation.—V.M.J.

8881 **Faul, Henry.** Ages of rocks, planets, and stars: New York, McGraw-Hill Book Co., 109 p., illus., tables, 1966.

Technical advances made in geochronology and astrophysics in the last 20 years or so make it possible to examine a multitude of events based on nuclear effects. Principles of measuring long periods of elapsed time on Earth are based on radioactive decay. Chapter headings are: radioactivity; nuclear clocks; limits and conditions of the accumulation clock; concordant, discordant, and mixed ages; geologic time scale; plumbology and the "age of the Earth"; history of meteorites;

and ages of stars and galaxies. Appendixes contain a chart of decay series of U-238, U-235, and Th-232; analytical procedures; and what is meant by "error".—E.S.L.

Felix, C. J. *See* Scull, B. J. 8476

8854 **Feth, J. H.** Reconnaissance survey of ground-water quality in the Great Basin, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D237-D241, illus., tables, 1966.

The Great Basin is noted for its areas of excessive heat, negligible precipitation, and commercially valuable brines. Nevertheless, virtually all valleys in the region produce some potable ground water. More than 80 percent of 2,731 analyses of ground water show less than 1,000 ppm of dissolved-solids, although some brines contain as much as 325,000 ppm, mostly sodium chloride. There is a wide diversity of chemical types; in the lower ranges of concentration the waters are typically of calcium or sodium bicarbonate types, whereas sodium or calcium sulfate or chloride types dominate the higher ranges. Some supplies are renewable, but in other basins all pumpage seemingly is from storage alone.—Author's abstract

Fidler, Richard E. *See* Norris, Stanley E. 8845

Finlayson, J. B. *See* Barnes, I. L. 8578

8757 **Finn, W. D. Liam.** Earthquake stability of cohesive slopes: Am. Soc. Civil Engineers Proc., v. 92, paper 4602, Jour. Soil Mechanics and Found. Div., no. SM 1, p. 1-11, illus., 1966.

The earthquake stability of a long cohesive slope is examined with regard to the effect of shear strain rate on shearing resistance. The slope is assumed to be underlain by an appreciably stiffer layer at a depth, h. The acceleration at which the slope begins to yield is shown to be a function of slope angle, soil strength and density, and the depth, h. When an acceleration greater than the yield acceleration acts on the slope, two distinct deformation patterns occur; a surface layer moves down the slope as a rigid body and between the surface layer and the stiff layer the soil undergoes plastic shearing deformation. Expressions are derived for the velocity and depth of the surface layer, and the velocity distribution in the plastic zone. Similar expressions are derived for slopes initially undergoing steady state creep. The meager experimental data available indicates the theoretical results are plausible.—Author's abstract

8734 **Fireman, Edward L.** Neutron exposure ages of meteorites: Zeitschr. Naturforschung, v. 21a, no. 7, p. 1138-1146, illus., tables, 1966.

The amount of shielding of meteorite samples while in space was estimated from Co-60 and Ar-39 measured on a number of recent falls. Co-60 activity in the Murray carbonaceous chondrite was very high compared to other chondrites, though the Ar-39 activities were almost identical. In the iron meteorites there was an inverse relation between Co-60 and Ar-39 activities; shielding increased Co-60 activity and decreased that of Ar-39. In Abee and Bruderheim neutron exposure ages were obtained from Kr-80/Co-60, Kr-82/Co-60, and Xe-128/Co-60; these ages were about an order of magnitude larger than the spallation exposure ages, a difference which can be attributed to space erosion or to an ancient neutron irradiation. D.B.V.

8892 **Fisher, Richard V.** Geology of a Miocene ignimbrite layer, John Day Formation, eastern Oregon: California Univ. Pubs. Geol. Sci., v. 67, 73 p., illus., tables, 1966.

Mineral-grain studies have been made of about 200 samples from an area of some 1500 sq mi of a rhyolitic to dacite ignimbrite sequence and an underlying air-fall tuff unit that occurs within the middle part of the John Day Formation (Middle Oligocene-Lower Miocene). The ignimbrite sequence moved from west to east, as shown by decreasing thickness and size of lithic fragments to the east. The upper part of one cooling unit contains more calcic plagioclase, less iron-rich clinopyroxene, and more magnetite than the lower part, which suggests the upper

part was derived from deeper in the magma chamber . It is postulated that the magma chamber was vertical and narrow, thereby inhibiting large-scale convective mixing and causing the development of a steep temperature gradient soon after the magma was injected into the conduit.—D.C.R.

8697 **Flaxman, Elliott M.; Barr, David I. H.; Herbertson, John G.; Rathbun, Ronald E.; Goswami, Atul; Raudkivi, A. J.; Sutherland, Alex J.** Sediment transportation mechanics—Initiation of motion. Discussions [of paper 4738, 1966 by A.S.C.E., Task Comm.]: Am. Soc. Civil Engineers Proc., v. 92, Jour. Hydraulics Div., no. HY 6, p. 245–256, illus., table, 1966.

Flaxman contends that "cohesive" is too broad a term and proposes that it be modified by "undisturbed," "disturbed," or "remolded." A further modifier indicative of moisture level should be inserted. In the opinion of Barr and Herbertson, sediment transportation has become overburdened by complex terminology, and they submit an alternative approach to Shields' correlation. Rathbun and Goswami offer some clarification on dune and ripple beds. Raudkivi believes that more emphasis could be given to the role of turbulence, and Sutherland believes the key point is the observation that, "Near critical conditions, the motion of grains in any small area of bed occurs in gusts whose incidence increases as the mean shear stress increases."—E.S.L.

8855 **Fleming, J. F.; Screwvala, F. N.; Kondner, Robert L.** Foundation superstructure interaction under earthquake motion, *in* World Conf. Earthquake Eng., 3d, New Zealand, 1965, Proc., V. 1: Wellington, New Zealand Inst. Engineers, p. I-22—I-30, illus., 1965 [1966].

A method of analysis is presented for determining the dynamic response of structures under earthquake motion taking into account the flexibility of the foundation. The structure is replaced by a lumped mass mathematical model which is attached to the moving rock layer by a flexible member having the same force-displacement relationship as the foundation. Several example problems are discussed which show the effect of the soil stiffness upon the response of the structure.—Authors' abstract

8657 **Folinsbee, R. E.; Baadsgaard, H.; Cumming, G. L.** A very ancient island arc [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Symposium, no. 10, p. 7, 1966.

8834 **Folk, Robert L.** A review of grain-size parameters: Sedimentology, v. 6, no. 2, p. 73–93, illus., tables, 1966.

This paper comprises a review of the many graphical and mathematical techniques that have been proposed for the statistical summary of grain-size data. Satellitic problems, such as laboratory techniques, choice of size scales, and interpretation, are only considered briefly.—Author's summary

8778 **Foreman, Helen P.** Two Cretaceous radiolarian genera: Micropaleontology, v. 12, no. 3, p. 355–359, illus., 1966.

Investigation of Cretaceous radiolarian assemblages from North America, the West Indies, Europe, Australia, and the East Indies has shown the necessity of emending the definition of *Artostrobium*, and of erecting the new genus *Amphipyndax*. [The type species *Amphipyndax enesseffi*, n. sp., is described from Cuba].—Author's abstract

8755 **Foster, Roy W.** Sources for lightweight shale aggregate in New Mexico: New Mexico Bur. Mines and Mineral Resources Bull. 88, 86 p., illus., tables, 1966.

Of the 42 shales sampled and tested, four are considered suitable for aggregate, and six others may be but require additional testing. Testing of Devonian shales in central New Mexico indicates that the carbonate content is too high. Pennsylvanian shales are too intimately interbedded, and have very short expansion ranges; however, a deposit near Abo Pass, and one in the Mud Springs Mts. have possibilities. The Cretaceous Pierre Shale in the northeast contains large deposits with good expansion properties, and the Mancos Shale contains possible sources

in the Mount Powell and Carthage areas. All samples were tested initially by flash firing at 2,100°F for 15 minutes; after examination favorable shales were tested further. Each locality sampled is described, and specific gravity, weight, absorption, and internal structure are discussed for the more favorable deposits.—E.S.L.

8768 **Fowler, Gerald A.; Kulm, L. D.** A multiple corer: Limnology and Oceanography, v. 11, no. 4, p. 630–633, illus., 1966.

The multiple corer, which has five barrels, operates on the principle of the gravity corer and contains the same components. Construction and operation are described.—E.S.L.

8536 **Frank, F. C.** A further note on dilatancy in relation to seismic sources [reply to discussion by E. Orowan of 1965 paper]: Rev. Geophysics, v. 4, no. 3, p. 405–408, 1966; corrections to 1965 paper, ibid., p. 410, 1966.

Frank suggests that the main point at issue between his viewpoint and that of Orowan is a semantic one, and proceeds to distinguish between dilatancy, dilatancy hardening, and dilatancy pumping. Frank regards the key point in his paper as the segregation and retention of fluid by dilatancy pumping which will occur in a homogeneously stressed system once the inflection in the dilatancy curve is passed; the process gradually accumulates fluid from surroundings in increasingly fluid-rich laminar shear zones leading to a catastrophic collapse.—V.S.N.

8492 **Free, Dwight A., Jr.** West Black Bay, Black Bay, and East Black Bay fields, Plaquemines Parish, Louisiana [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2327, 1966.

8485 **Freeman, Paul S.** Extrusive shale masses—New Gulf Coast exploration frontier [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2324–2325, 1966.

8894 **Freeze, R. Allan; Witherspoon, P. A.** Theoretical analysis of regional groundwater flow—[Pt.] 1, Analytical and numerical solutions to the mathematical model: Water Resources Research, v. 2, no. 4, p. 641–656, illus., 1966.

It is possible to represent steady-state regional ground-water flow in a three dimensional, nonhomogeneous, anisotropic basin by a mathematical model. The numerical finite-difference approach can be used to solve the general case; the analytical separation of variables technique is restricted to two-dimensional layered mediums. The numerical method is more versatile, mathematically simpler, and well suited to computer oriented methods of data storage. Computer results are in the form of plotted potential nets from which flow patterns can be constructed.—Authors' abstract

8440 **Freeze, Roy Allan.** Theoretical analysis of regional groundwater flow [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 829B, 1966.

Friedman, I. *See* Clayton, R. N. 8448

Frondel, Clifford. *See* Meinschein, Warren G. 8833

Fullerton, Donald S. *See* Wilson, Charles W., Jr. 8695

8559 **Furumoto, A. S.** Seismic refraction study of the internal structure of a volcanic cinder cone [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Div. Mtg. Solid Earth Physics I, p. 25, 1966.

8561 **Furumoto, A. S.; Maynard, G. L.** Seismograph stations operated on several Pacific islands [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Div. Mtg. Solid Earth Physics I, p. 34, 1966.

Furumoto, A. S. *See* Pararas-Carayannis, George. 8562

Fyles, J. G. *See* Dyck, W. 8750

8457 **Gaal, Robert Arthur Paul.** Marine geology of the Santa Catalina Basin area, California [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 858B–859B, 1966.

Gaskill, D. L. *See* Young, L. L. 8886

Gemperle, M. *See* Dehlinger, P. 8554

8465 **Gernant, Robert E.; Kesling, Robert V.** Foraminiferal paleoecology and paleoenvironmental reconstruction of Oligocene Middle Frio in Chambers County, Texas [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2321, 1966.

8381 **Gerrard, Thomas A.** Environmental studies of Fort Apache Member, Supai Formation, east-central Arizona: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 11, p. 2434–2463, illus., table, 1966.

The "Fort Apache Limestone Member" defines a Permian limestone facies within the Fort Apache Indian Reservation. This paper establishes a widespread dolomite facies to the northwest in the Mogollon Rim region and an evaporite-dolomite facies to the north in the Holbrook basin, and suggests that "Fort Apache Member" would be more appropriate. The member is thickest (about 140 feet) some 40 miles ENE of Fort Apache. Petrographic and textural studies indicate that these rocks were originally aragonitic or calcitic muds that accumulated in a shallow marine environment free of persistant currents or wave motions but periodically subjected to vigorous agitation of the sea bottom. Probably the dolomite is of early diagenetic (syngenetic) origin.—B.H.K.

8815 **Gershanik, S.; Sierra, P.; Jaschek, E.** Tabla para localización expeditiva de focos sísmicos profundos [also English text]: Geofísica Internac., v. 6, no. 1, p. 23–31, illus., tables, 1966.

The rapid methods so far known for the location of deep earthquake foci and based on data from a single station cannot be applied when the epicentral distance is short. In view of this consideration, a new method free from such limitation, and based on P, S, and ScS phases, and in tables prepared for such purpose, is proposed.—Authors' English abstract

8354 **Gibbs, J. F.; Roller, J. C.** Crustal structure determined by seismic refraction measurements between the Nevada Test Site and Ludlow, California, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D125–D131, illus., table, 1966.

Seismic-refraction measurements from nuclear and chemical explosions were made to determine the crustal structure along a line from the Nevada Test Site (NTS) to Ludlow, Calif. Additional recordings from nuclear explosions were made southward toward Calexico, Calif. The thicknesses of the successive crustal layers at NTS are $h_0 = 1.0$ km ($v_0 = 2.5$ km/sec), $h_1 = 13$ km ($v_1 = 6.1$ km/sec), and $h_2 = 20$ km ($v_2 = 6.8$ km/sec); the total crustal thickness is 34 km. The successive crustal layers at Ludlow have thicknesses of $h_0 = 1.4$ km, $h_1 = 13$ km, and $h_2 = 13$ km; the total crustal thickness is 17 km.—Authors' abstract

8766 **Gibson, L. B.** Some unifying characteristics of species diversity: Cushman Found. Foram. Research Contr., v. 17, pt. 4, p. 117–124, illus., table, 1966.

Benthonic species diversity, or the relative concentration of species in a population, is viewed as being related to environmental dynamics. It is proposed that the geographic distributions of species diversity can be used to reliably map net variability within environments in marine areas. The distribution of foraminiferal diversity in the Mississippi Sound [Gulf of Mexico] is used to illustrate correlation between environmental variability and population diversity. Populations of low diversity were found associated with environments of high wave and current activity or conditions in which salinity, temperature and turbidity, as a function of depth, were unstable. With increasing depth and the stabilization of these factors, population diversity increased.—*from* Author's abstract

8788 **Giese, R. F., Jr.** Crystal structure of kernite, $Na_2B_4O_6(OH)_2 \cdot 3H_2O$: Science, v. 154, no. 3755, p. 1453–1454, illus., table, 1966.

Kernite, $Na_2B_4O_6(OH)_2 \cdot 3H_2O$, contains parallel infinite chains of the borate polyanion $[B_4O_6(OH)_2]_n$. The chains are composed of six-membered rings containing one boron-oxygen triangle and two boron-oxygen tetrahedra. The rings are linked through commonly shared boron-oxygen tetrahedra.—Author's abstract

8740 **Gill, James R.; Cobban, William A.** The Red Bird section of the Upper Cretaceous Pierre Shale in Wyoming, *with a section on* A new echinoid from the Cretaceous Pierre Shale of eastern Wyoming by Porter M. Kier: U.S. Geol. Survey Prof. Paper 393-A, p. A1–A73, illus., tables, geol. map, 1966.

In the vicinity of Red Bird, Wyo., Late Cretaceous Pierre Shale is well exposed and consists of dark- to light-gray-weathering non-calcareous clayey to silty shale that is entirely of marine origin. Seven lithologic units are described. A section 3,100 feet thick measured on the northwest flank of Old Woman anticline, a large fold en echelon to structures of the Black Hills, is presented as a reference locality for the Pierre Shale of the northern Great Plains; it rests on the Niobrara Formation and is overlain by the Fox Hills Sandstone; both contacts are conformable and gradational. Well preserved megafossils, chiefly ammonites and inoceramids, are abundant above the Sharon Springs Member. Beginning at the base of the Sharon Springs Member, 18 ammonite zones can be recognized. The depositional environment is discussed and a geologic map and detailed measured section are included.—B.S.H.

8527 **Giret, Raoul I.** Reply [to discussion by W. C. Kellogg, 1966, of "Some results of aeromagnetic surveying with a digital cesium vapor magnetometer," 1965]: Geophysics, v. 31, no. 4, p. 827–828, 1966.

Kellogg's criticisms (ibid., p. 824–826, 1966) are answered in the light of considerable experience with high-sensitivity magnetic surveying, which is quite different from conventional airborne surveying. It has been found that the number of anomalies interpreted from a high-sensitivity survey is two to four times greater than those which can be usefully worked out on a low-sensitivity one.—D.B.V.

8510 **Glaeser, J. Douglas.** Provenance, dispersal, and depositional environments of Triassic sediments in the Newark-Gettysburg basin: Pennsylvania Geol. Survey, 4th ser., Bull. G 43 (General Geology Rept.), 168 p., illus., tables, geol. maps, 1966.

Above laterally equivalent Stockton and New Oxford Formations, a red coarse clastic Hammer Creek Formation grades west and southwest into finer grained Gettysburg Formation, and eastward into red Brunswick and gray Lockatong lithosomes. Petrographic data indicate the provenance of the Stockton and New Oxford Formations as granitic or high-grade metamorphic terrane a short distance south of the basin margin and of the Hammer Creek and equivalent strata as sedimentary or low-grade metamorphic rocks north of the outcrop margin. The finest grained sediments accumulated under low-energy center-basin conditions. Pod-shaped conglomerate bodies in upper Brunswick and Gettysburg strata are considered to be mudflow. Detrital hematite is indicated. Binocular microscope analysis and thin-section data are given in appendixes.—G.D.C.

8439 **Gnirk, Paul Farrell.** An investigation of some aspects of contained explosion phenomena in rock [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 846B, 1966.

8831 **Goldstein, J. I.** Butler, Missouri—An unusual iron meteorite: Science, v. 153, no. 3739, p. 975–976, illus., 1966.

The Butler iron meteorite has been found to have, with respect to other iron meteorites, an unusually high cobalt content (1.4 percent by weight), unusually high germanium content in the kamacite and the taenite phases, and an unusually low cooling rate (0.5°C/10^6 years). It is suggested that Butler formed in a different environment from that of the rest of the iron meteorites.—Author's abstract

8403 **Goldstein, N. E.; Ward, S. H.** The separation of remanent from induced magnetism in situ: Geophysics, v. 31, no. 4, p. 779–796, illus., tables, 1966.

Remanent and induced magnetism both contribute to static field magnetic anomalies whereas only induced magnetism contributes to dynamic field magnetic anomalies. The theory whereby this phenomenon may be used to advantage for in-situ separation of remanent from induced magnetism is presented as a prelude to observational evidence confirming the phenomenon. Four field experiments on Western States magnetic anomalies prove that it is possible to predict whether or not a given static field magnetic anomaly is primarily due to remanent or to induced magnetism. The limitations of the method include variability of micropulsation field direction, ellipticity, and intensity.—Authors' abstract

Gomez, Manuel. *See* Koch, G. S., Jr. 8525

Good, Donald I. *See* Pierce, Jack W. 8427

8552 **Gordon, Robert B.; Nelson, Carl W.** Anelastic properties of the Earth: Rev. Geophysics, v. 4, no. 4, p. 457–474, illus., 1966.

To find likely sources of seismic attenuation in the Earth's mantle, laboratory data on rocks determined at low temperatures are not useful but those determined at high temperatures on sintered oxides can indicate important damping mechanisms. Attenuation is caused by viscous grain boundary damping, stress-induced ordering, and dislocation damping; or in partially melted mantle, by stress-induced flow of liquid through intergranular channels. Resulting internal friction shows strong frequency dependence, and, with thermally activated relaxation, its variation with depth can account for existing data on the anelasticity of the Earth. Low attenuation at depths below 500 km can result from decreasing atomic mobility, the observed decrease not in itself evidence of phase change. In relation to strength of the mantle, seismic damping sets no useful lower limit.—G.D.C.

Goswami, Atul. *See* Flaxman, Elliott M. 8697

Goth, Joseph H., Jr. *See* Lytle, William S. 8713

Graf, D. L. *See* Clayton, R. N. 8448

8545 **Graf, D. L.** New graduate program in hydrogeology at the University of Minnesota: Ground Water, v. 4, no. 4, p. 33–35, illus., 1966.

A graduate program in hydrogeology is described, in which the field is defined as encompassing the whole range of processes operating in water and water-mineral mixtures at and near the Earth's surface. The interdisciplinary character of this training is insured by requiring both a minor from another department and course work in other subdisciplines of hydrogeology in addition to the one in which the thesis is carried out. The importance of nonscientific aspects of hydrogeology is recognized by allowing for minors in fields such as economics and business administration.—Author's abstract

Graf, Donald L. *See* Anderson, Raymond J. 8787

Grandjean, Mary Ann. *See* Bieberman, Robert A. 8518

8482 **Gregory, Jack Lee.** Lower Oligocene delta in subsurface of southeastern Texas [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2323, 1966.

Grolier, Maurice J. *See* Bingham, James W. 8421

8879 **Guerra-Pena, F.** Interpretación fotogeológica del delta del río Balsas [also English and French texts]: Photo Interprétation, no. 66-2, p. 1–7, illus., 1966.

A stereoscopic set of airphotos of the Michoacan-Guerrero boundary area, Mexico, with an interpretative overlay and brief text comprise the paper. Photogeologic analysis of the Balsas delta reveals three distinct zones: the former delta, with an

arched shape, flood and low-water channels, and fossil meanders; the subsidiary delta, where one can see the last stage, deposited mainly by the right arm of the Balsas and showing direction of growth; and the underwater delta, also arched, growing rapidly, and following the west-east direction of the ocean currents. Remarkable underwater dunes form at the east end of the delta. Judging by the deltas, the left arm of the river carries very little sediment.—E.S.L.

8839 **Gulbrandsen, R. A.** Precambrian phosphorite in the Belt Series in Montana, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D199-D202, illus., table, 1966.

A thin bed of phosphorite (23.5 percent P_2O_5) found in the younger part of the Precambrian Belt Series in Montana is one of only a small number of phosphorite occurrences of this age known in the world. It may contain fossils; one distinct structure observed in thin section is similar to a sponge spicule. Knowledge that phosphorites have formed in Precambrian times should provide incentive for exploration in such previously overlooked terranes, although some lines of evidence indicate that Precambrian phosphorite may be rare.—Author's abstract

8763 **Guliov, Paul.** Two new Middle Albian species of Foraminifera from Saskatchewan: Cushman Found. Foram. Research Contr., v. 17, pt. 4, p. 142-143, illus., 1966.

Two new species of arenaceous Foraminifera are described from the lower part of the Joli Fou Formation (Cretaceous) from boreholes in several localities in Saskatchewan. About 100 specimens each were collected of *Ammodiscus anthosatus* (Ammodiscidae) and *Ammomarginulina asperata* (Lituolidae). The latter is briefly distinguished from three Cretaceous species of *Ammobaculites* which it resembles. Direct association of *Ammomarginulina* with *Inoceramus comancheanus* supports a late Middle Albian age for the formation.—V.M.J.

8667 **Gunter, B. D.; Musgrave, B. C.** Gas chromatographic measurements of hydrothermal emanations at Yellowstone National Park: Geochim. et Cosmochim. Acta, v. 30, no. 11, p. 1175-1189, illus., tables, 1966.

Over 100 gas samples from Yellowstone National Park have been analyzed by gas chromatography. The gases emitted by the thermal features are categorized according to the type of spring. The source of methane is discussed in terms of presently available information, and it is concluded that additional isotope analyses are essential to establish the source of this gas. The non-reactive gases are treated by a Rayleigh distillation process which gives a strong correlation between argon and all of the other non-reactive gases although the correlation with helium is not as well defined as for the other gases. This is interpreted to indicate a predominantly atmospheric origin for these gases.—Authors' abstract

Halunen, A. J. *See* Kroenke, L. W. 8557

8863 **Halverson, Harry T.** The strong motion accelerograph, *in* World Conf. Earthquake Eng., 3d, New Zealand, 1965, Proc., V. 1: Wellington, New Zealand Inst. Engineers, p. III-75—III-93, illus., table, 1965 [1966].

The increasing emphasis by engineering seismologists and earthquake engineers on the acquisition of true ground acceleration data has stimulated the development of several new strong motion accelerographs. This is of interest to the seismologist concerned with continuous data acquisition beyond the range of the standard seismic instruments, and of interest to the structural or earthquake engineer requiring acceleration data to calculate or evaluate structural response to strong local seismic shocks. A summarization of the characteristics of the significant strong motion accelerographs of the various countries is presented, together with available information on world-wide strong motion accelerograph installations, and typical strong motion accelerograph records.—Author's abstract

8480 **Ham, H. H.** A method of estimating formation pressures from Gulf Coast well logs [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2322, 1966.

8547 **Hamilton, Warren; Myers, W. Bradley.** Cenozoic tectonics of the western United States: Rev. Geophysics, v. 4, no. 4, p. 509–549, illus., 1966.

Cenozoic structures of the western United States define northwestward horizontal motion of the crust increasing toward coastal California. Aggregate right-lateral displacement of Cretaceous and older rocks is about 500 km, mostly along the San Andreas fault; current velocity is eight times faster than needed to account for total movement. The coastal sliver including Baja California may drift independently, with the north end deflected at the oceanic Mendocino scarp. Lava piles of the Northwest are in a region which was oceanic before Cenozoic time; in the Snake River Plain, volcanic material fills a tension rift through Mesozoic crust which pivoted away from the Idaho batholith. The Sierra Nevada and Klamath Mountains rotated counterclockwise, forming the block-faulted Basin-Range province behind them. In lanes between blocks, slip-strike faults displaced up to 50 and 80 km.—G.D.C.

8816 **Hanna, G. Dallas; Brigger, A. L.** Fossil diatoms from southern Baja California: California Acad. Sci. Proc., 4th ser., v. 30, no. 15, p. 286–308, illus., 1966.

Thirty-five Miocene diatoms from the Santiago area are classified and described briefly, and 23 are illustrated.—E.S.L.

8677 **Harbaugh, John W.** Mathematical simulation of marine sedimentation with IBM 7090/7094 computers: Kansas Geol. Survey Computer Contr. 1, 52 p., illus., tables, 1966.

In symbolic three-dimensional space, the model imitates the processes of tectonic warping, winnowing of sediments along beaches, formation of deltas, and the growth and interaction of organism communities. A set of external controlling conditions is fed into the computer as numerical data, and the model run forward, by increments, through geologic time. Several million years can be studied in fifteen minutes. Output is in the form of lithofacies, structure, biofacies, and sea-water depth maps, with cross sections. The mathematical model is embodied in a BALGOL computer language program, the principles of which are outlined. Detailed operating instructions are given also, and 13 pages of maps and sections are included.—E.S.L.

8802 **Harris, DeVerle P.** A probability model of mineral wealth: Soc. Mining Engineers Trans., v. 235, no. 2, p. 199–216, illus., tables, 1966.

The construction of a model to associate probability of occurrence of some measure of mineral wealth with the geology for each subdivision (cell) of the area is postulated. A case study of 97,000 sq mi in Arizona and New Mexico was conducted by measuring mineral wealth and geologic variables in 243 cells. The variables quantified the theoretical concepts of the model. It was found that the multivariate statistical models of multiple discriminant analysis and classification by Bayesian statistics and multivariate normal probability function provide a means for relating the concepts of probability, geology, and mineral wealth. The ultimate use of such a model is extrapolation of information from a known to an unknown area.—*from* Author's abstract

8409 **Harris, Donald Clayton.** The application of x ray spectroscopy to the study of three new ore minerals [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 899B, 1966.

8464 **Harrison, Frank W.; Anderson, Robert A.** Sub-regional report of *Camerina* Zone, southwest Louisiana [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2319, 1966.

8889 **Harshbarger, J. W.; Lewis, D. D.; Skibitzke, H. E.; Heckler, W. L.; Kister, L. R.; Baldwin, H. L.** Arizona water: U.S. Geol. Survey Water-Supply Paper 1648, 85 p., illus., 1966.

This report discusses Arizona's problems of high evaporation, scarcity of surface water, declining ground-water levels, and soil salinity. It considers possible methods

of water conservation, and suggests ways of better water management to avoid future shortage. The report is nontechnical and is designed to be read by the general public as well as the professional. This paper was revised by H. L. Baldwin. W.L.G.

8422 **Harvey, Richard D.** Thermal expansion of certain Illinois limestones: Illinois Geol. Survey Indus. Minerals Note 24, 6 p., illus., table, 1966.

The thermal expansion of 16 samples of limestone, representing the principal commercial formations of the state, was observed through a range of −4° to 140°F by means of a dilatometer. This range includes the usual extremes to which Illinois limestones might be exposed during a normal year. The mean linear coefficient of thermal expansion perpendicular to the bedding of the stone was most commonly 2.2×10^{-6} (.0000022) per degree F, but several coarse-grained limestones had coefficients that ranged as high as 3.9×10^{-6} (.0000039) per degree F. The expansion of the fine-grained limestones proceeded at a nearly constant rate throughout the test, but the coarse-grained limestones expanded more rapidly as the temperature increased.—*from* Author's abstract

8532 **Hashimoto, Mitsuo.** On the prehnite-pumpellyite metagraywacke facies [in Japanese with English abs.]: Geol. Soc. Japan Jour., v. 72, no. 5, p. 253–265, illus., 1966.

Studies on seven regional metamorphic terrains in which the zone of prehnite pumpellyite metagraywacke facies is revealed are reviewed, along with brief references to other occurrences of the prehnite-pumpellyite facies rocks. In addition to areas in New Zealand, New South Wales, and Japan, the Barranquitas of Puerto Rico and Izee in central Oregon are included. Mineralogy of these rocks and the status in facies series of this mineral facies are discussed in some detail. It is suggested that a new mineral facies exists, named the pumpellyite-actinolite schist facies, surrounded by the prehnite-pumpellyite metagraywacke, the greenschist and the glaucophane schist facies.—*from* Author's English abstract

8499 **Haskell, E. E., Jr.; Leventhal, J. S.; Bianchi, W. C.** The use of tritium to measure the movement of groundwater toward irrigation wells in western Fresno County, California: Jour. Geophys. Research, v. 71, no. 16, p. 3849–3859, illus., tables, 1966.

The tritium content of water from irrigation wells along two east-west traverse lines was used in estimating groundwater velocities in the San Joaquin Valley. Tritium peaks due to nuclear weapons tests were identified within the groundwater body. The estimated velocities were comparable with velocities expected in the coarse parts of the aquifers. The ratio of tritium in the well water to that in the rain was inconsistent with predicted recharge, indicating that recharge was localized and that water flowed to the sample wells through the coarse aquifers.—Authors' abstract

8736 **Hawkins, M. E.; Jirik, C. J.** Salt domes in Texas, Louisiana, Mississippi, Alabama, and offshore tidelands—A survey: U.S. Bur. Mines Inf. Circ. 8313, 78 p., illus., tables, 1966.

About 40 percent of the salt produced in the United States in 1964 came from 24 out of 329 proved salt domes in the Gulf Coast States and adjoining offshore tidelands. Domes were also the source of 5.2 million tons of sulfur, are an important source of oil, and are increasingly used for storage of liquified petroleum gas. Listed in tables are location of each dome, notes about mineral or fuel production, and, where known, depth to caprock, to salt, and volume of salt.—A.P.B.

Hayes, Philip T. *See* Simons, Frank S. 8853

Heckler, W. L. *See* Harshbarger, J. W. 8889

Hedley, D. G. F. *See* Parsons, R. C. 8529

8377 **Heezen, Bruce C.; Sheridan, Robert E.** Lower Cretaceous rocks (Neocomian-Albian) dredged from Blake Escarpment: Science, v. 154, no. 3757, p. 1644–1647, illus., table, 1966.

Algal calcarenites, Neocomian to Aptian in age, dredged from 3,000- to 5,000-meter depth on Blake Escarpment, are the oldest rocks yet obtained from deep-sea outcrops. Five thousand meters of post-Aptian subsidence of the Blake Plateau is thus established. Aptian-Albian calcilutites obtained from depths of less than 3,000 meters mark the establishment of an offshore environment.—Authors' abstract

Heier, K. S. *See* Morgan, J. W. 8419

Heintz, K. O. *See* Howell, Lynn G. 8435

Hellner, E. *See* Donnay, J. D. H. 8508

Herbertson, John G. *See* Flaxman, Elliott M. 8697

Herbertson, John G. *See* Barr, David I. H. 8698

8856 **Herrera, Ismael; Rosenblueth, Emilio.** Response spectra on stratified soil, *in* World Conf. Earthquake Eng., 3d, New Zealand, 1965, Proc., V. 1: Wellington, New Zealand Inst. Engineers, p. I-44—I-60, illus., 1965 [1966].

Paper concerns the probability distribution of spectral responses of viscously damped single-degree systems resting on stratified viscoelastic soil. The soil is assumed to rest on a viscoelastic homogeneous half space of rock. Motion arriving at the rock-soil interface is idealized as a stationary Gaussian process. The transfer function for the soil formation is treated independently for each vibration frequency of interest, in order to allow for dependence of viscoelastic parameters on the wave frequency; this is accomplished through use of a matrix formulation. Certain additional approximate results are included.—Authors' abstract

8857 **Herrera, Ismael; Rosenblueth, Emilio; Rascń, O. A.** Earthquake spectrum prediction for the Valley of Mexico, *in* World Conf. Earthquake Eng., 3d, New Zealand, 1965, Proc., V. 1: Wellington, New Zealand Inst. Engineers, p. I-61—I-74, illus., table, 1965 [1966].

Paper reports field and laboratory tests to determine the dynamic properties of Mexico City clay. The data are used in conjunction with a linear, one-dimensional theory of multiple wave reflection in stratified media and the results are treated in accordance with an approximate theory, which permits computing the probability distributions of spectral responses for various degrees of damping. Expected spectra are compared with those obtained from earthquake records. Missing information for deep strata is found by trial and error and velocities measured for the upper layers are adjusted on reasonable bases. The comparison is deemed good.—Authors' abstract

8817 **Hertlein, Leo George.** Pliocene fossils from Rancho El Refugio, Baja California, and Cerralvo Island, Mexico: California Acad. Sci. Proc., 4th ser., v. 30, no. 14, p. 265–284, illus., tables, 1966.

Fossils collected by the Academy expedition and two earlier ones, are listed and described, and some are illustrated. Half of the 64 specimens are pelecypods, including two new subspecies, and 13 are gastropods. Brief information on the collecting localities is given.—E.S.L.

Hicks, W. G. *See* Musgrave, A. W. 8512

8571 **Hill, D. P.** Crustal structure of the Island of Hawaii from seismic-refraction measurements [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Div. Mtg. Solid Earth Physics II, p. 20, 1966.

8503 **Hluza, A. G.** Main area of Fruitvale oil field: California Div. Oil and Gas, California Oil Fields—Summ. Operations 1965, v. 51, no. 2, p. 31–39, illus., table, 1966.

In the Main area of Fruitvale oil field the sedimentary section ranges in age from Eocene to Recent and varies in thickness from 8,500–11,570 feet. Thickening occurs generally in a southwesterly direction toward the center of the San Joaquin Valley. Sediments overlie a basement complex of schist considered to be upper Jurassic. The Main area lies on the westerly plunging Bakersfield arch. Accumulation of oil and gas is due to faulting, lateral decreases in permeability within the productive intervals, or a combination of both. Producing zones are the Fairhaven sand; Mason–Parker, Martin, and three Kernco zones; and the Santa Margarita Sandstone.—M.C.M.

8662 **Hodgson, J. H.; Wickens, A. J.; Stevens, A. E.** Earthquake mechanism studies particularly related to the circum-Pacific zone [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Symposium, no. 10, p. 23, 1966.

8533 **Hofmann, H. J.** Ordovician paleocurrents near Cincinnati, Ohio: Jour. Geology, v. 74, no. 6, p. 868–890, illus., tables, 1966.

Paleocurrent indicators in marine calcarenites of the Kope and Fairview Formations, of Late Ordovician age, show that the mean trend of Kope paleocurrents is westerly and that of Fairview paleocurrents is southerly. The wave length of ripple marks decreases upward from the upper third of the Kope to the upper third of the Fairview, and probably is related to shallowing of a broad, tidal sea and slackening of currents.—E.T.R.

8825 **Hogan, C. S.; Sipes, L. D., Jr.** Rock properties of Permian Basin formations, *in* Oil and gas fields in West Texas—Symposium: West Texas Geol. Soc. Pub. 66–52, p. 15–17, illus., table, 1966.

Core analysis data from the Permian basin, in the files of Core Labs., Inc., for approximately one-half million samples has been put onto punched cards for processing on high-speed computers. Information on each formation was sorted, and averages computed for the various characteristics were tabulated.—E.S.L.

8368 **Hollister, Lincoln S.** Garnet zoning—An interpretation based on the Rayleigh fractionation model: Science, v. 154, no. 3757, p. 1647–1651, illus., 1966.

Manganese zoning in almandine garnet is interpreted by the use of calculations based on the Rayleigh fractionation model. A close similarity of a measured manganese zoning profile and a calculated profile indicates that the assumptions used in the calculations are good. These assumptions are: complete removal of garnet from a homogeneous reservoir as the garnet crystallizes, and a nearly constant manganese fractionation factor between garnet and reservoir.—Author's abstract

8424 **Holm, J. L.; Kleppa, O. J.** The enthalpy of formation of kyanite (Al_2SiO_5): Inorganic Chemistry, v. 5, no. 4, p. 698, 1966.

The development by Yokokawa and Kleppa of new solution-calorimetric methods at high temperature permits determination of heats of formation of many previously inaccessible compounds. Kyanite was selected to illustrate the potential of the method, and a new value of the enthalpy of formation is reported, as formed from the component oxides at 695°, -2.37 ± 0.15 kcal/mole. Work is in progress on the other polymorphs.—E.S.L.

8684 **Holmes, G. William.** Early discoverers—[Pt.] 25, Stephen Reed, M. D., and the "celebrated" Richmond boulder train of Berkshire County, Massachusetts, U.S.A.: Jour. Glaciology, v. 6, no. 45, p. 431–437, illus., 1966.

Reed, an amateur geologist, is but dimly remembered for his contribution to glacial theory and for his pioneering descriptions of this sequence of large amphibolite boulders extending for several tens of kilometers southeastward into Massachusetts.

He first reported on it in the *Lenox Farmer* in 1842, and in 1845 presented a scientific paper to a national geological meeting which sparked a trans-Atlantic debate, which was not resolved until the concept of glaciation was widely accepted several decades later. The opinions of Hitchcock, Lyell, and a number of other geologists both professional and amateur are reviewed, but Stephen Reed deserves the most credit for presenting solid evidence supporting the theory of continental glaciation.—G.D.C.

8420 **Hood, Peter.** Flemish Cap, Galicia Bank, and continental drift: Earth and Planetary Sci. Letters, v. 1, no. 4, p. 205–208, illus., 1966.

It is proposed that a geophysical study be carried out of a strip about 250 miles wide stretching between Grand Banks of Newfoundland and the Galicia Bank off Spain. The primary objective would be to demonstrate that there is a two-sided symmetry about the axis of the Mid-Atlantic Ridge in the physical properties (e.g. remanent magnetization) and dimensions of the geological formations underlying the ocean floor. If this symmetry can be demonstrated to exist in the North Atlantic Ocean then the case for ocean-floor spreading (and presumably continental drift) will be greatly strengthened.—Author's abstract

8785 **Hooper, Kenneth.** A note on an anomalous miliolid: Micropaleontology, v. 12, no. 3, p. 371, illus., 1966.

An aberrant specimen of *Miliolinella* [sp. cf. *M. chukchiensis*] with two apertures, one at each end of the test, is described and figured [from Recent bottom sediments from the Newfoundland Grand Banks].—Author's abstract

Horowitz, Alan. *See* Carr, Donald C. 8803

Horowitz, N. H. *See* Miller, S. L. 8819

8864 **Housner, George W.** Intensity of earthquake ground shaking near the causative fault, *in* World Conf. Earthquake Eng., 3d, New Zealand, 1965, Proc., V. 1: Wellington, New Zealand Inst. Engineers, p. III-94—III-115, illus., table, 1965 [1966].

Data and analyses indicate an upper bound for intensity of ground shaking [based on studies of earthquakes along the San Andreas fault] that is approximately 50 percent greater than at El Centro [Calif.] during the earthquake of 18 May 1940. Upper bounds of 50 percent g for maximum ground acceleration and 45 seconds for duration of strong shaking are indicated. The intensity immediately adjacent to a fault is not especially severe but is, in general, somewhat less than at a distance of several miles. The maximum intensity of shaking associated with a magnitude 8.5 earthquake is less and that associated with a magnitude 5 earthquake is greater than has been commonly supposed.—Author's abstract

8435 **Howell, Lynn G.; Heintz, K. O.; Barry, A.** The development and use of a high-precision downhole gravity meter: Geophysics, v. 31, no. 4, p. 764–772, illus., tables, 1966.

The vibrating string downhole gravity meter described has a precision of about .01 mgal in gravity measurement. With measurements of this precision, density of a 30-ft section in the subsurface can be determined with an accuracy of .02 g per cm^3. These density measurements are useful in gravity interpretation, in computing acoustic impedance for use in seismology, and in estimating porosities of formations. Examples of density profiles measured in boreholes are given.—Authors' abstract

8408 **Hoyt, Philip Munro.** An investigation of pressure distribution in granular media by photoelastic means [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 811B–812B, 1966.

Hrabar, S. V. *See* Carr, Donald C. 8803

8743 **Huang, Ter-Chien.** A sedimentologic study of Charlotte Harbour, southwestern Florida: Florida State Univ. Sedimentol. Research Lab. Contr. 13, 97 p., illus., tables, 1966.

Multivariate non-linear regression was used to relate bottom sediment characteristics in Charlotte Harbour, Fla., to provenance, transportation, and depositional environments. The essentially terrigenous quartz sand and biogenic carbonate detritals have minor amounts of kaolinite, montmorillonite, attapulgite, and illite. The mean grain size as well as percentage of carbonate detritals increase seaward; the coarse fractions accumulate within high energy areas of the harbour mouth and channels, the finer aggregates in the harbour head and lagoons. This shows that the sediments were shifted by the two major tidal circulations of the harbour proper and of San Carlos Bay. Transport mechanisms and response of materials to physico-chemical and biological environments are discussed.—G.D.C.

8564 **Huang, Y. T.** On noise prediction techniques [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Div. Mtg. Solid Earth Physics 1, p. 41, 1966.

Hubbard, Douglass H. *See* Macdonald, Gordon A. 8675

8456 **Hudec, Peter Paul.** The nature of water and ice in carbonate rock pores [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 859B, 1966.

8794 **Hurr, R. Theodore.** A new approach for estimating transmissibility from specific capacity: Water Resources Research, v. 2, no. 4, p. 657-664, illus., tables, 1966.

Transmissibility estimated from specific capacity is subject to error, because effects of duration of pumping and specific yield are not evaluated. Rearrangement of the Theis equation provides a mathematical relation for evaluating drawdown during nonequilibrium conditions and delayed yield from storage at any time after pumping begins. The only term that needs to be assumed is specific yield. The curves presented were used to construct a transmissibility map of the valley-fill aquifer in the Arkansas River valley of Colorado. The map was the foundation for an analog-model analysis of the aquifer system. The transmissibilities estimated from the type curves correlate well with those determined from aquifer tests and estimated from test-hole logs.—*from* Author's abstract

8671 **Hyden, Harold J.** Geologic map of the Bengough Hill quadrangle, Albany and Carbon Counties, Wyoming: U.S. Geol. Survey Geol. Quad. Map GQ-579, scale 1:24,000, sections, text, 1966.

Proven commercial resources of the Bengough Hill quadrangle are: oil and natural gas from the Muddy Sandstone Member of the Thermopolis Shale, and Shannon Sand of the Steele Shale; and coal in the Mesaverde and Foote Creek Formations. Quaternary gravel beds are of potential value.—M.C.M.

8384 **Ichiye, Takashi.** Some hydrodynamic problems for a nepheloid zone: Pure and Appl. Geophysics, v. 63, p. 179-195, illus., table, 1966.

Ewing and Thorndike (1965) discovered a layer a few hundred meters thick with suspended matter (nepheloid zone) near the bottom on the continental slope of the North Atlantic. The hydrodynamics of such a layer are examined here. The trajectories of turbidity currents are computed from motion of a mass of mud under the Coriolis force and friction, and the results are applied to those inferred by Hand and Emery (1964) in the San Diego trough off California.—D.B.V.

Imbrie, John. *See* Turekian, Karl K. 8416

8414 **Isaacs, Kalman N.** The simulation of magnetic and gravity profiles by digital computer: Geophysics, v. 31, no. 4, p. 773-778, illus., 1966.

A method is discussed and demonstrated which enables the magnetic or gravity profile of a two-dimensional geologic structure section to be determined by a relatively small digital computer. This method has no restrictions with regard to

inclination of the field, remanent magnetization, or complexity of the section. Its chief use is as an objective means of verifying, theoretically, the structural validity of a geologic section interpreted from a magnetic or gravity profile.—Author's abstract

Jackman, H. W. *See* Ehrlinger, H. P., 3d. 8501

8358 **Jackson, Everett D.** "Eclogite" in Hawaiian basalts, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D151-D157, illus., table, 1966.

Preliminary results of an investigation of xenoliths in Hawaiian basalt include new data on the garnet-clinopyroxene rocks called "eclogite". Garnet-bearing xenoliths, previously known to occur in the Salt Lake Tuff, Oahu, have been found in the Aliamanu and Makalapa Tuffs as well. Xenoliths in these tuffs are of two dominant types—one containing about 75 percent clinopyroxene, 15 percent garnet, and 10 percent olivine; the other about 75 percent olivine, 15 percent orthopyroxene, and 10 percent clinopyroxene. But xenoliths gradational between these two types are found, and the two types are interlayered in some single hand specimens. It seems clear that the "eclogite" xenoliths are members of a very heterogeneous group of deep-seated rocks whose origin cannot be considered separately from each other or from the origin of their host rocks.—Author's abstract

Jackson, J. W. *See* Veevers, J. J. 8385

Jaschek, E. *See* Gershanik, S. 8815

Jenkins, C. T. *See* Moore, J. E. 8895

8519 **Jenness, S. E.** (compiler). Abstracts of publications in scientific journals by officers of the Geological Survey of Canada, 1965: Canada Geol. Survey Paper 66-4, 56 p., 1966.

8862 **Jenschke, V. A.; Clough, R. W.; Penzien, J.** Characteristics of strong ground motions, *in* World Conf. Earthquake Eng., 3d, New Zealand, 1965, Proc., V. 1: Wellington, New Zealand Inst. Engineers, p. III-125—III-142, illus., tables, 1965 [1966].

Three methods, namely probabilistic, Fourier spectra and response spectra were used to investigate characteristics of strong ground motions like earthquakes and underground nuclear explosions. A description is given of the results obtained with special emphasis on the response spectra method. The intrinsic relations and properties of five different response spectra are studied. A peak spectral frequency is defined allowing one to classify events as having acceleration spectra of low, medium or high peak spectral frequency type. Apart from the effect of other geophysical parameters a correlation is shown to exist between peak spectral frequency and epicentral distance.—Authors' abstract

8526 **Jensen, Homer.** Reply [to discussion by W. C. Kellogg, 1966, of "Instrument details and applications of a new airborne magnetometer," 1965]: Geophysics, v. 31, no. 4, p. 826-827, 1966.

In reply to Kellogg's criticisms (ibid., p. 824-826, 1966), Jensen maintains that with the doppler systems it is possible to achieve a straightness of line and constancy of along-line scale which cannot be approached by any other method. Use of constant scale tape and digital presentation is also defended.—D.B.V.

8417 **Jensen, Oliver; Ellis, R. M.; Russell, R. D.** Analysis of Canadian Long Shot data: Earth and Planetary Sci. Letters, v. 1, no. 4, p. 211-221, illus., tables, 1966.

A pilot analysis of the [Aleutian] Project Long Shot nuclear explosion data received by Canadian seismic stations indicates a compressional first arrival as expected, except at one station. At all stations the P-phase arrived earlier than predicted with the largest residuals at the most distant sites. A comparison earthquake in the Rat Islands area indicates a similar bias trend. The average unified magnitude and standard deviation for all Canadian stations agrees well with the worldwide

average determination. Surface waves, recorded at four stations, gave magnitudes from 4.9 to 5.2. The P-wave amplitudes appear to be anomalously low in central British Columbia and high in eastern Canada. Spectral investigations show both common and individual characteristics among the stations.—*from* Authors' abstract

Jirik, C. J. *See* Hawkins, M. E. 8736

John, Edward C. *See* Purtymun, William D. 8848

Johnson, David G. *See* Turekian, Karl K. 8680

Johnson, George L. *See* Purtymun, William D. 8848

8451 **Johnson, Gerald Glenn, Jr.** A mathematical analysis of terrestrial impact craters [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 932B, 1966.

8706 **Johnson, J. G.** *Parachonetes*, a new Lower and Middle Devonian brachiopod genus: Palaeontology, v. 9, pt. 3, p. 365–370, illus., 1966.

Parachonetes is proposed as a new chonetid genus with *Chonetes macrostriata* Walcott from Nevada as its type species. It is thought to have been derived from the protochonetid genus *Eccentricosta*. Barrande's species *Chonetes verneuili* is assigned to *Parachonetes*, as are two named species from southeastern Australia. *Parachonetes* is absent in eastern North America, but is represented in Nevada, the Canadian Arctic, Novaya Zemlya, the Ural Mts., central and southeastern Asia, Czechoslovakia, and southeastern Australia.—Author's abstract

8563 **Johnson, R. H.; Norris, R. A.; Duennebier, F. K.** T phases with high frequency peaks [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Div. Mtg. Solid Earth Physics I, p. 39, 1966.

8888 **Jones, Benjamin L.** Effects of agricultural conservation practices on the hydrology of Corey Creek basin, Pennsylvania, 1954–60: U.S. Geol. Survey Water-Supply Paper 1532-C, p. C1–C55, illus., tables, 1966.

Data collected during the period 1954–60 are used to describe the differences and similarities in precipitation, streamflow, and sedimentation in both the natural and artificially created environments of Corey Creek and Elk Run basins. Multiple regression analyses demonstrate that of all variables, runoff correlated most closely with sediment yield of each basin. Trend analyses of data show no persistent changes in quantity of runoff, precipitation, or runoff intensity, but do show significant changes in rate of suspended-sediment discharge. During the period 1957–60, sediment discharge from Corey Creek basin decreased by 11 percent relative to the sediment discharge from Elk Run; most of this reduction occurred during the May–October growing season and only about one-fourth of the annual sediment yield occurred during the growing season.—W.L.G.

Jones, Blair F. *See* Anderson, Raymond J. 8787

8345 **Jones, David L.; Detterman, Robert L.** Cretaceous stratigraphy of the Kamishak Hills, Alaska Peninsula, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D53–D58, illus., 1966.

Cretaceous rocks of the Kamishak Hills area, Alaska Peninsula, rest conformably on Upper Jurassic strata and are subdivided into two formations. The lowermost formation, of Early Cretaceous age, is unnamed and comprises two units. The lower unit consists of 200 feet or more of gray shaly siltstone with numerous 1-ft-thick beds of *Inoceramus*-prism calcarenite of late Hauterivian to early Barremian age. The upper unit consists of 200–300 feet of rusty brownish-gray siltstone of Barremian age. This is the first known occurrence of strata of these ages on the Alaska Peninsula. The uppermost Cretaceous Kaguyak Formation overlies the Lower Cretaceous beds with slight angular unconformity and is of Maestrichtian age.—Authors' abstract

8737 **Kaarsberg, E. A.** Electron photomicrographs of some anisotropic sedimentary rocks: Soc. Mining Engineers Trans., v. 235, no. 2, p. 123–126, illus., 1966.

Electron photomicrographs shown are of samples of the A.P.I. Reference Clay Minerals Montmorillonite No. 27 and Kaolinite No. 4, and of a shale from Spraberry oil field in Texas. Elastic anisotropy was determined in the montmorillonite and shale samples by sound velocity measurements, and the electron photomicrographs indicate the preferred orientation of the mica-like particles. Velocity measurements on the kaolinite did not indicate elastic anisotropy, and the photomicrograph does not show any noticeable orientation of the books of which it is composed.—E.S.L.

8742 **Kaesler, Roger L.** Quantitative re-evaluation of ecology and distribution of Recent Foraminifera and Ostracoda of Todos Santos Bay, Baja California, Mexico: Kansas Univ. Paleont. Contr.—Paper 10, 50 p., illus., tables, 1966.

Environmental and faunal data on Foraminifera (Walton, 1955) and Ostracoda (Benson, 1959) from this area were used to test applicability of quantitative methods of numerical taxonomy to biofacies analysis. Presence-absence data were employed because counts of specimens per species at each station were unreliable indicators of environmental similarity. The method assumes existence of mappable biofacies and biotopes and adequate sampling. If total populations are considered, high positive correlation must exist between distribution of live and dead organisms. Results of the quantitative method are objective and repeatable, computation is rapid, results may be expressed graphically, and choice of similarity level is clearly arbitrary and relative. Biofacies analyses are closely similar to those based on qualitative interpretation.—G.D.C.

8468 **Kamp, Katherine M.** Classification of Neogene cones (Mollusca, Gastropoda, genus *Conus*) from southeastern United States and Caribbean [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2326, 1966.

Kanamori, Hiroo. *See* Takeuchi, Hitoshi, 8447

8804 **Keefer, W. R.; VanLieu, J. A.** Paleozoic formations in the Wind River Basin, Wyoming: U.S. Geol. Survey Prof. Paper 495-B, p. B1-B60, illus., tables, 1966.

The Wind River Basin of central Wyoming is a structural depression bounded by the Granite, Wind River, Washakie, Owl Creek, and Bighorn Mountains and by the Casper arch, all formed during the Laramide deformation of Late Cretaceous and early Tertiary times. In this paper, basic data are summarized on the distribution, thickness, lithology, paleontology, and depositional history of the Paleozoic formations of the basin and adjacent ranges obtained during detailed geologic mapping and stratigraphic studies begun in the early 1940's. Paleozoic rocks, principally the Park City Formation and Tensleep Sandstone, are among the most important oil and gas reservoirs of the basin.—V.S.N.

8438 **Keevil, Norman Bell, Jr.** Exploration at the Craigmont mine, British Columbia [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 846B-847B, 1966.

8699 **Kehn, Thomas M.** Geologic map of the Dawson Springs quadrangle, western Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-573, scale 1:24,000, section, text, 1966.

Coal has been mined in the Dawson Springs quadrangle since 1890, but all underground mines were abandoned before 1966. Although some beds have been mined by stripping, most are too thin or impure to be of economic importance. Deposits of sandstone, shale, underclay, and limestone have been exploited only for local use.—M.C.M.

Kelley, Dana R. *See* Lytle, William S. 8713

8714 **Kelley, Dana R.** The Kastle Medina gas field, Crawford County, *in* Oil and gas developments in Pennsylvania, 1965: Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 172, p. 30-44, illus., 1966.

The Kastle gas field, producing from Medina sands, was discovered in 1962 and has produced ever since, about 1,500 MCFGPD. Pay sandstones are described, and structure contour and isopach maps are included.—E.S.L.

Kerr, P. F. *See* Davidson, D. M., Jr. 8799

Kesling, Robert V. *See* Gernant, Robert E. 8465

8813 **Kesling, Robert V.** *Trochiliscus bellatulus* Peck from the Middle Devonian Dundee Limestone of northwestern Ohio: Michigan Univ. Mus. Paleontology Contr., v. 20, no. 7, p. 179–194, illus., tables, 1966.

Charophytes from the Dundee Limestone in Lucas County, Ohio, are identified as *Trochiliscus bellatulus* Peck, previously known only from the Columbus Limestone.—Author's abstract

8801 **Keyes, D. A.** Geology of the IMC potash deposit, Esterhazy, Saskatchewan: Soc. Mining Engineers Trans., v. 235, no. 2, p. 186–191, illus., table, 1966.

A potash-rich zone in the Devonian Prairie Evaporite Formation is being mined near Esterhazy. The ore is a sylvite-halite mixture (sylvinite), containing some insoluble material and a limited amount of carnallite. Bodies of salt filling cracks or sinkholes interrupt the sylvite mineralization. Several sections are included.—E.S.L.

8730 **Kier, Porter M.** A new echinoid from the Cretaceous Pierre Shale of eastern Wyoming, *in* The Red Bird section of the Upper Cretaceous Pierre Shale in Wyoming: U.S. Geol. Survey Prof. Paper 393-A, p. A62–A65, illus., 1966.

A new genus, *Eurysalenia*, of the family Acrosaleniidae is here described from the Pierre Shale of Wyoming. Hundreds of specimens of the type species, *Eurysalenia minima* Kier, new species, occur in a limestone concretion. The concentration of specimens may have been caused by the crowding of the echinoids to spawn or to feed upon a large dead animal.—*from* Author's abstract

Kilburn, Chabot. *See* Turcan, A. N., Jr. 8846

8550 **Kirkland, D. W.; Bradbury, J. P.; Dean, W. E., Jr.** Origin of Carmen Island salt deposit, Baja California, Mexico: Jour. Geology, v. 74, no. 6, p. 932–938, illus., table, 1966.

The Carmen Island deposit, containing beds of halite and gypsum, is adjacent to but isolated from the Gulf of California by a reef and alluvium. A bay, formed there by inundation of a small graben in late Pleistocene or Recent time, was closed off by the reef and slight uplift. The resulting lagoon filled chiefly with evaporites as sea water, which washed over and seeped through the reef, evaporated.—D.R.M.

Kister, L. R. *See* Harshbarger, J. W. 8889

Kittrick, J. A. *See* Moodie, C. D. 8716

8747 **Klapper, Gilbert.** Upper Devonian and Lower Mississippian conodont zones in Montana, Wyoming, and South Dakota: Kansas Univ. Paleont. Contr.—Paper 3, 43 p., illus., 1966.

Three conodont zones, one Upper Devonian and two Lower Mississippian, have been recognized on a regional basis in Montana, Wyoming, and South Dakota. The Devonian–Mississippian boundary has been located precisely within the Englewood Formation of Boxelder Canyon, Black Hills, and a dark shale unit in Cottonwood Canyon, Big Horn Mountains. This dark shale unit is a widespread transgressive unit subjacent to either the Madison or Lodgepole Limestone and overlying a significant regional unconformity, demonstrated by the fact that the shale unit truncates all members of the Three Forks and Jefferson Formations. The taxonomic section includes a discussion of 34 species, which are referred to 11

genera. Two new species of *Dinodus* and *Siphonodella* are described.—*from* Author's abstract

Kleppa, O. J. *See* Holm, J. L. 8424

8390 **Knopoff, L.; Burridge, R.** Theoretical and model seismicity [abs.], *in* Internat. Symposium Geophys. Theory and Computers, 2d, Rehovoth, Israel, 1965, Proc.: Royal Astron. Soc. Geophys. Jour., v. 11, nos. 1–2, p. 265, 1966.

8828 **Knopoff, L.; Pilant, W. L.** A proposal for a seismological study of the Gulf of California [also Spanish text]: Geofísica Internac., v. 6, no. 1, p. 1–21, illus., 1966.

From a review of seismic activity in the Gulf of California and along the San Andreas fault, it appears that the southern Gulf may not be part of the San Andreas system, but may have formed by an open break in the crust with a rotation of the lower half westward. It should be possible to resolve this and other structural problems associated with the origin of the Gulf and of the Peninsula of Baja California by means of a program of both short- and long-period seismic observations. Similar studies of Alpine and Mediterranean structure are reviewed.—E.S.L.

8712 **Knowles, Raymond R.** Geology of a portion of the Everett 15-minute quadrangle, Bedford County, Pennsylvania: Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 170, 90 p., illus., geol. map, 1966.

Folded and faulted sedimentary rocks, ranging in age from Upper Cambrian to Middle Devonian, with a total thickness of about 12,500 feet, were mapped in the quadrangle. Dolomitization of the Cambrian Warrior and Gatesburg Formations took place after they were deposited and was limited to those parts containing clastic or detrital grains. Principal structures are the Friends Cove and Warrior Ridge anticlines and Yellow Creek syncline; cores of both anticlines are broken by high-angle faults. Regional interpretation suggests that low-angle thrust faulting produced the existing folded and faulted structures. Structural relief on the Friends Cove anticline is about 10,000 feet, and on the Hyndman anticline about 6,000. These anticlines probably represent westward displacement of about three miles. An appendix gives detailed stratigraphic descriptions of selected formations.—E.S.L.

8525 **Koch, G. S., Jr.; Gomez, Manuel.** Delineation of Texas lignite beds by statistical techniques: U.S. Bur. Mines Rept. Inv. 6833, 38 p., illus., tables, 1966.

Core data from 361 drill holes in the Wilcox Formation in central Texas were subjected to statistical studies involving correlation of lignite seams, mean seam thickness determination, and quadratic regression analysis. Six lenticular lignite beds that were delineated within the 8×2 mile area established by the drill holes have indicated reserves of 214.2 million tons; an area extending 2,000 feet beyond this area contains probable reserves of 113 million tons. The study demonstrates the reliability of the statistical method, and suggests that core drilling can be optimized to yield maximum information with minimum drill holes.—H.R.B.

8748 **Koczy, F. F.** Seawater: Internat. Sci. and Technology, no. 60, p. 52–54, 56, 61–64, illus., 1966.

Sea water, a solution of strong electrolytes, gases, and organic components, also contains considerable undissolved organic material and inorganic mineral fragments. It is the Earth substance whose gross chemical composition is best known, but whose fundamental chemical equilibria is least understood. Chemical reactions are largely determined by phenomena which occur at interfaces, air-water and water-sediment being the major ones. The role of metabolism in water chemistry and its practical results is discussed. Residence times of the elements vary greatly depending on their reactivity. For example, examination of the chemical behavior of calcium reveals striking discrepancies in its calculated residence time and abundance.—E.S.L.

8859 **Kondner, Robert L.; Krizek, Raymond J.** Dynamic response of cohesive soils for earthquake considerations, *in* World Conf. Earthquake Eng., 3d, New Zealand, 1965,

Proc., V. 1: Wellington, New Zealand Inst. Engineers, p. I-96—I-106, illus., 1965 [1966].

Energy storage and dissipation characteristics of cohesive soil are important in earthquake phenomena. These are studied in steady state vibratory uniaxial compression. The soil response is represented in terms of viscoelastic parameters and shows definite nonlinear (underlinear) behavior, even at small values of dynamic strain. Phase angles (dissipation measure) between applied strains and resulting stresses are small and require special instrumentation. Nonlinear response gives calculated compression moduli and propagation velocities which decrease with dynamic stress or strain level. For the limited range considered, applied static stress level has little effect on the dynamic response.—Authors' abstract

Kondner, Robert L. *See* Fleming, J. F. 8855

8858 **Kondner, Robert L.** Characteristic periods of cohesive soil–foundation systems, *in* World Conf. Earthquake Eng., 3d, New Zealand, 1965, Proc., V. 1: Wellington, New Zealand Inst. Engineers, p. I-75—I-82, illus., 1965 [1966].

Characteristic periods associated with both resonant and zero force level phenomena and important in the design of soil–structure systems under transient loadings are presented for prototype circular footings supported on a cohesive soil. Interrelated effects of footing diameters ranging from 5 ft–2 in to 10 ft–4 in, total weights from 6.41 tons to 25.64 tons, static pressure levels from 2.56 psi to 10.25 psi, and level of dynamic loading are considered. Periods vary as a power of the total weight and inversely as a power of the contact footing area. Dynamic force level effects indicate a nonlinear (underlinear) nature for the cohesive soil–foundation systems considered.—Author's abstract

Krinitzsky, Ellis L. *See* Turnbull, Willard J. 8770

8885 **Krinov, E. L.** Giant meteorites [translated from the Russian by J. S. Romankiewicz]: Oxford, England, Pergamon Press, 397 p., illus., tables, 1966.

This book is divided into four parts. Part 1 covers meteorite craters on the surface of the Earth, including the fall of crater-forming meteorites, both impact and explosion types, and descriptions of 12 authentic meteorite craters and of 11 suspected meteorite craters. The other three parts give detailed descriptions of the Arizona (Barringer) Meteorite Crater, the Tunguska meteorite, and the Sikhote-Aline iron meteorite shower. An appendix presents new data in support of a meteorite impact origin for the Brent, Holleford, and Deep Bay craters.—E.S.L.

Krizek, Raymond J. *See* Kondner, Robert L. 8859

8553 **Kroenke, L. W.; Walker, D. A.; Maynard, G. L.** Gravity measurements on Midway Island and reef [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council, Japan, Div. Mtg. Solid Earth Physics I, p. 4, 1966.

8557 **Kroenke, L. W.; Halunen, A. J.; Woollard, G. P.** Reflection profiles across Penguin Banks, Hawaii [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Div. Mtg. Solid Earth Physics I, p. 23, 1966.

Krupp, H. K. *See* Elrick, D. E. 8897

Kuberry, R. *See* Nelson, J. H. 8570

Kullerud, G. *See* Morimoto, N. 8507

Kulm, L. D. *See* Fowler, Gerald A. 8768

8865 **Lacer, Donald A.** A simulation of earthquake amplification spectra for southern California sites, *in* World Conf. Earthquake Eng., 3d, New Zealand, 1965, Proc., V. 1: Wellington, New Zealand Inst. Engineers, p. III-151—III-167, illus., tables, 1965 [1966].

A mathematical model is developed for estimating the maximum ground motion to be expected at a given site in a given time period. More than 2,000 simulated earthquakes are generated using Monte Carlo and other statistical techniques. A digital computer program is used to calculate the maximum velocity spectra at several southern California sites due to the simulated earthquakes. It is concluded that the simulated earthquake approach is a reasonable analytic method that can be refined to yield results which will be of importance in earthquake resistant structural design.—Author's abstract

LaFrance, Gary G. *See* Majumdar, Dalim K. 8761

8884 **Lamar, D. L.; Merifield, P. M.** Length of Devonian day from Scrutton's coral data: Jour. Geophys. Research, v. 71, no. 18, p. 4429–4430, illus., 1966.

A method is derived which gives an independent determination of the length of the Devonian day from Scrutton's (1964) data. The variation in length of the day as a function of number of days in the synodic month is plotted in a graph; also plotted are the length of the Devonian day from Scrutton's and Wells' (1963) data; the results are remarkably consistent in view of the fact that entirely different periodicities were considered in each study.—D.B.V.

8348 **LaMarche, Valmore C., Jr.** An 800-year history of stream erosion as indicated by botanical evidence, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D83–D86, illus., 1966.

Under certain conditions recent erosional events on small streams are recorded in the histories of adjacent trees—exposed roots can indicate higher past levels of a streambed, and rapid uncovering of a tree's root system may result in growth suppression. According to this interpretation of external form and internal growth features of two trees, degradation by an ephemeral stream in southwestern Utah has totaled 10 feet since 1150 A.D. Erosion was apparently accelerated about 1700. Features of the nearby flood plain suggest that downcutting of this ephemeral tributary was triggered by a lateral shift of the channel of the master stream. Thus, the downcutting may not be related to an erosional cycle of regional extent. Author's abstract

8873 **Lamey, Carl A.** Metallic and industrial mineral deposits: New York, McGraw-Hill Book Co., 567 p., illus., tables, 1966.

This deals with the characteristics and origin of mineral deposits in general, the metallic deposits, and the industrial deposits. The formation of mineral deposits (part 1) is a summary of major concepts rather than an advanced treatment and is considered under three categories: those formed by igneous activity, by metamorphic activity, and by surface agencies. Part 2 treats the more important deposits of 31 metals throughout the world with ideas that have been advanced as to their origin. The industrial deposits, except fuels, are discussed briefly in part 3; their world-wide production is presented in graphs and tables. Other tables show the world rank of the more productive countries for various materials from 1949–59.—E.S.L.

8537 **LaMoreaux, P. E.** Activities of the Hydrogeologic Map Committee of the International Association of Scientific Hydrology: Ground Water, v. 4, no. 4, p. 28–32, illus., 1966.

It is the purpose of this paper to call attention to the existence of the International Hydrogeologic Map Display and the International Legend for Hydrogeologic Maps, and to encourage those in the United States working in water resources and associated fields to review these recommendations and forward their comments for use at the next meeting of this international committee. The recommended legend is included, and it is requested that any maps following it be forwarded for the committee's file and for use in the display at the next General Assembly.—*from* Author's abstract

8502 **Land, P. E.; Anderson, David N.** Midway-Sunset oil field: California Div. Oil and Gas, California Oil Fields—Summ. Operations 1965, v. 51, no. 2, p. 21–29, illus., table, 1966.

Midway-Sunset field in Kern County ranks second in the state in both daily and cumulative oil production and first in areal extent. Basic structure is a regional homocline, along the east flank of the Temblor uplift, modified by several folds and converging unconformities. Producing zones are the Pleistocene Tulare tar sand, Pliocene San Joaquin and Etchegoin Formations, and Miocene Reef Ridge and Antelope Shale.—M.C.M.

Lander, W. T. *See* Safford, J. M. 8521

Langbein, W. B. *See* Scheidegger, A. E. 8687

Langbein, W. B. *See* Scheidegger, A. E. 8711

Langford, S. A. *See* Belshé, J. C. 8569

Langway, C. C., Jr. *See* Crozaz, G. 8413

8478 **Lankford, Robert** Patterns of foraminiferal distribution, northwest Gulf of Mexico [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2322, 1966.

Lanphere, Marvin A. *See* Miller, Thomas P. 8359

8838 **Lanphere, Marvin A.** Potassium–argon ages of Tertiary plutons in the Prince William Sound region, Alaska, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D195–D198, illus., table, 1966.

Potassium–argon ages of biotite and hornblende from four plutons in the western part of Prince William Sound, in southern Alaska, range from 34.4 to 36.6 m.y. with a mean age of 35.8 m.y. These data indicate that emplacement of the plutons occurred early in the Oligocene.—Author's abstract

Laur, Peter. *See* Meinschein, Warren G. 8833

Lennon, K. *See* Naughton, J. J. 8579

Leo, G. M. *See* Cannaday, F. X. 8402

8432 **Lerman, A.** Boron in clays and estimation of paleosalinities: Sedimentology, v. 6, no. 4, p. 267–286, illus., tables, 1966.

Four clays were kept for eight months in solutions of artificial sea water containing varying concentrations of boron; boron uptake was proportional to concentration and took place in a relatively short time. The occurrence of a sodium–borate complex in saline waters also appears to promote boron adsorption. Boron concentrations in Late Cretaceous marine sediments cropping out around the southern Appalachians show variation much greater than accounted for by a model which assumes nearly constant boron concentration in clays prior to deposition, and changes in boron concentration in solution as may be expected under slight variations in sea water. Differences in properties of clay–mineral polymorphs, in predepositional histories of clays, and possible adsorption from interstitial waters, render inconsequential estimates of boron concentrations in waters at time of deposition.—E.S.L.

Leventhal, J. S. *See* Haskell, E. E., Jr. 8499

Lewis, D. D. *See* Harshbarger, J. W. 8889

8490 **Lewis, Jackson E.** Paleoecological study of Pleistocene marine fauna, Flagler County, Florida [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2326, 1966.

8789 **Lidz, Louis.** Deep-sea Pleistocene biostratigraphy: Science, v. 154, no. 3755, p. 1448-1452, illus., tables, 1966.

Results of the first detailed paleontological analysis of a deep-sea piston-core from the Caribbean Sea are reported. Samples for foraminiferal analysis were taken at 10-cm intervals and split into smaller samples containing an average of 710 individuals (smallest sample, 517 individuals); all individuals were then identified and counted. Temperature oscillations were determined by using ratios of the relative abundances of tropical and subtropical planktonic Foraminifera to those found in temperate and cooler waters. These ratios correlate well with oxygen isotope paleotemperature measurements for the same core.—D.B.V.

8486 **Limes, Leonard L.** Paleoclimatology—A new dimension in oil exploration [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2325, 1966.

8681 **Lindsay, John F.** Observations on the level of a self-draining lake on the Casement Glacier, Alaska [with French and German abs.]: Jour. Glaciology, v. 6, no. 45, p. 443-445, illus., 1966.

A small ice-dammed glacial lake beside the Casement Glacier in southeastern Alaska was observed to drain in two separate pulses during the summer of 1965. The initial discharge appears to have resulted when the ice lobe damming the lake was floated by the increasing depth of water. There is no good explanation for the second rapid discharge but it may have been due to the sudden opening of crevasses.—Author's abstract

8790 **Lindsey, David A.** Sediment transport in a Precambrian ice age—The Huronian Gowganda Formation: Science, v. 154, no. 3755, p. 1442-1443, illus., 1966.

The Gowganda Formation of Ontario consists of conglomerates, quartzites, and argillites deposited in a glacial environment. The distribution of varved argillites and silty limestones suggests continental and marine facies, respectively. Pebble and ripple-drift orientations, distribution of limestones, striated pavements, distribution of the underlying Bruce Group, and Huronian quartzite paleocurrents support the conclusion that sediment transport was from north to south.—Author's abstract

8796 **Lipman, P. W.; Christiansen, Robert L.; O'Connor, J. T.** A compositionally zoned ash-flow sheet in southern Nevada: U.S. Geol. Survey Prof. Paper 524-F, p. F1-F47, illus., tables, 1966.

Ash-flow sheets in southern Nevada display systematic chemical and mineralogical zonations which appear to reflect vertical variations in magmas from which sheets were erupted. The Topopah Spring Member, a widespread ash-flow sheet of Paintbrush Tuff of Miocene(?) and Pliocene age, is typical of such compositionally zoned units. Principal compositional zonation of tuffs is from basal crystal-poor rhyolite to capping crystal-rich quartz latite. An upward increase in phenocryst content is accompanied by systematic variations in phenocryst proportions. The systematic sequence of compositional variations suggests that each sheet formed by eruption of successively lower parts of a zoned magma body in which relatively crystal-poor rhyolitic magma overlay crystal-rich quartz latitic magma. Chemical variation suggests fractional separation of crystals from liquid under conditions of near equilibrium.—*from* Authors' abstract

Lippert, R. H. *See* O'Leary, Mont. 8678

8847 **Lipscomb, Robert G.** The winter phytoplankton, and physical and chemical characteristics of Pretty Lake, Indiana, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D242-D249, illus., tables, 1966.

Wintertime data from a small lake show that after ice formed on the surface a distinct phytoplankton population developed and declined at a depth of water that suggests heterotrophy. Diatom species of the Bacillariophyceae were the dominant phytoplankton. During the peak concentration of cells *Cyclotella bodanica* Eulenstein predominated. The temperature of the lake increased by a few degrees

during the ice-cover period, and the peak algal concentration was coincident with the maximum water temperature at a depth of 40 feet. Except for silica, nitrate, and pH, chemical data did not correlate with fluctuations in the phytoplankton population. By late season, quality of the deep water had been affected by winter stagnation; dissolved oxygen became deficient, pH decreased, and the decay product H_2S (hydrogen sulfide) became readily detectable.—Author's abstract

8391 **Lomnitz, C.** Simulation of California earthquake sequences by Monte Carlo methods [abs.], *in* Internat. Symposium Geophys. Theory and Computers, 2d, Rehovoth, Israel, 1965, Proc.: Royal Astron. Soc. Geophys. Jour., v. 11, nos. 1–2, p. 266, 1966.

8551 **Lomnitz, C.** Statistical prediction of earthquakes: Rev. Geophysics, v. 4, no. 3, p. 377–393, table, 1966.

Historical attempts at prediction of earthquakes have centered on the question of periodicity. Present evidence indicates earthquakes to be uncorrelated events. It is fallacious to infer properties of the earthquake process on the basis of shape of the distribution function of number of events in time. Some restrictions are shown to apply to use of direct extrapolation methods in earthquake time series. Multiple prediction is a possibility, but direct measurements of stresses and strains at depth are needed. Plotting square roots of earthquake energies yields no specific strain information of predictive value. The estimation of earthquake risks is different from the prediction problem, as mathematical techniques are available. A simplified model of the earthquake process is suggested, which may satisfy elementary requirements.—*from* Author's abstract

Lowdon, J. A. *See* Dyck, W. 8750

Lowe, Donald R. *See* Dickinson, William R. 8369

8843 **Lowry, Marlin E.** The White River Formation as an aquifer in southeastern Wyoming and adjacent parts of Nebraska and Colorado, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D217–D222, illus., 1966.

Many large-yield water wells in southeastern Wyoming, northeastern Colorado, and southwestern Nebraska reportedly tap the White River Formation, of Oligocene age, which is predominantly siltstone. However, most of these wells probably tap overlying alluvium that is composed of pebbles derived from the White River Formation rather than the White River Formation itself. Although previous workers have suggested that various kinds of fractures are the water-conducting openings where large yields are known to be derived from the White River, the openings are thought more likely to be tubes formed by piping before the formation was buried by alluvium.—Author's abstract

8758 **Lumb, Peter.** Stability of slopes in anisotropic soils—Discussion [of paper 4405 by K. Y. Lo, 1965]: Am. Soc. Civil Engineers Proc., v. 92, paper 4594, Jour. Soil Mechanics and Found. Div., no. SM 1, p. 199–203, illus., 1966.

A rational interpretation of anisotropic strength can be made by using a modification of the maximum shear strain energy failure criterion which has been described by Hill. This failure criterion also agrees with experimental values but leads to a completely different conclusion as to stability of anisotropic soils than that reached by the author. This criterion, and Casagrande and Carrillo's Eq. 2 from the paper, are applied to stability problems, including vane tests and plane strain. This leads to the conclusion that the stability of a slope in anisotropic soil must be greater than or equal to the stability of a similar slope in an isotropic soil for the same value of vertical compression strength.—E.S.L.

8713 **Lytle, William S.; Goth, Joseph H., Jr.; Kelley, Dana R.; McGlade, William G.; Wagner, Walter R.** Oil and gas developments in Pennsylvania in 1965: Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 172, 66 p., illus., tables, 1966.

Shallow- and deep-sand exploration and development are reviewed. There were 893 new wells drilled and 28 deepened during 1965; of the 893, 28 were exploratory

deep tests, 5 of which were successful. Two papers on selected deep gas pools are cited separately. Records of deep wells are summarized in a table, and a bibliography of Pennsylvania geology for 1965 is included.—E.S.L.

8675 **Macdonald, Gordon A.; Hubbard, Douglass H.** Volcanoes of the National Parks in Hawaii (3d edition): Hawaii Volcanoes Natl. Park, Hawaii Nat. History Assoc., 52 p., illus., tables, revised 1966; originally published 1951.

Hawaiian mountains were born when a fissure opened in a northwest–southeast direction across the Pacific Ocean floor, probably during late Tertiary; volcanism appears to have progressed southeastward. Commonest lava is olivine basalt grading into andesite; lava flows are *pahoehoe* and *aa* types. Because of lava fluidity and lower gas content, volcanic activity is relatively gentle but with high speeds of flow. Mauna Loa, world's largest active volcano, is of shield type, and during the past century has been one of the most active on Earth; its activity and eruptions are described and tabulated. Kilauea differs from Mauna Loa in greater amount of explosive debris in the caldera's vicinity and the lava lake activity in the caldera; its eruptions since 1952 are described and illustrated. Haleakala on Maui is the only volcano outside the island of Hawaii that has erupted during the last few hundred years.—E.S.L.

8539 **Macias Villada, Mario.** Evolución de las clasificaciones de los suelos en el mundo [with French, Portuguese, and English abs.]: Rev. Ingeniería Hidrául. México, v. 20, no. 1, p. 79–93, illus., 1966; conclusion, ibid., no. 2, p. 67–81, illus., tables, 1966.

The first step in soil classification is by geologic aspect, *in situ*, and secondary soils; the second is based on quantity of the two principal components, and divides them into organic, organic–mineral, and mineral soils. Alteration of detritus or regolith in four climatic zones is discussed and principal historical classifications are listed. Conditions in the three areas in which soil science developed—eastern Europe, Russia, and the United States—led to three systems of classification; a summary of other considerations in different general systems of classification is listed. Soils of the Yucatan Peninsula and their geologic relations are discussed, and a soil map of the Valley of Mexico is included. The paper concludes with the classification system of Baldwin, Kellogg, and Thorp, 1960.—E.S.L.

8362 **MacNeil, F. Stearns.** Middle Tertiary sedimentary regimen of Gulf Coastal region: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 11, p. 2344–2365, illus., 1966.

The middle Tertiary sedimentary regimen of the Gulf Coast is related directly to Rocky Mountain events, and most of the terrigenous sediments came from the Rocky Mountains. Correlation between the surface and subsurface is based on equation with transgressive and regressive phases. Criteria are given for identifying these phases. Gulf coastal stages are delimited by regressive maximums. The outer-shelf shale tongues, which are usually identified by distinctive foraminiferal assemblages, are regarded as regressive maximums. The *Textularia warreni* tongue of the subsurface Vicksburg and the Anhuac tongue represent transgressive peaks.—W.C.C.

Maddock, Thomas, Jr. *See* Barr, David I. H. 8698

8396 **Mah, A. D.** Thermodynamic properties of vanadium and its compounds: U.S. Bur. Mines Rept. Inv. 6727, 84 p., tables, 1966.

Heat capacities, entropies, heat contents, heats of vaporization, free energies of vaporization, vapor pressures, temperatures of phase changes, heats of phase changes, heats of formation, and free energies of formation are tabulated for vanadium and its inorganic compounds. Heats, free energies, equilibrium pressures, and equilibrium constants are tabulated for reactions of vanadium compounds, with special emphasis on metallurgical reactions. A third section supplies basic thermodynamic data for elements and compounds associated with metallurgical reactions of vanadium. Sufficient auxiliary data has been included so that the

calculated values contained in this paper may be followed or new calculations made for related metallurgical reactions.—H.R.B.

8761 **Majumdar, Dalim K.; LaFrance, Gary G.** A method for earthquake resistant design of earth dams—Discussion [of paper 4616 by H. B. Seed, 1966]: Am. Soc. Civil Engineers Proc., v. 92, paper 4958, Jour. Soil Mechanics and Found. Div., no. SM 6, p. 251–254, illus., table, 1966.

The writers outline a procedure developed for readily obtaining a preliminary estimate of slope requirements for a homogeneous earth embankment subject to earthquake loading. This analysis involves the extension of the stability chart formulated by D. W. Taylor to account for a statically applied, horizontal earthquake force.—E.S.L.

8786 **Mangelsdorf, Paul C., Jr.** Calcium and bromide contents of natural waters [discussion of paper by R. J. Anderson, D. L. Graf, and B. F. Jones, 1966]: Science, v. 154, no. 3755, p. 1473, 1966.

A line of unit slope would fit just as well the log–log scatter plot of Ca^{++} and Br^{--} contents of Anderson, Graf and Jones' group of natural waters (ibid., v. 153, p. 1637, 1966). It would be more instructive to draw a line of unit slope through their seawater point; the fact that almost all the data fall on the calcium-rich side of such a line, but less than a decade removed from it, is much firmer evidence of both a common seawater origin and the proposed calcium-enrichment process.—D.B.V.

8558 **Manghnani, M. H.; Woollard, G. P.** Elastic properties of some inclusive ultramafics in Hawaiian volcanic rocks [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Div. Mtg. Solid Earth Physics I, p. 24, 1966.

8574 **Manghnani, M. H.** Structural control of infrared absorption characteristics of glauconites [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Div. Mtg. Solid Earth Physics II, p. 35, 1966.

8844 **Marine, I. Wendell.** Hydraulic correlation of fracture zones in buried crystalline rock at the Savannah River Plant, near Aiken, South Carolina, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D223–D227, illus., 1966.

Two types of open fractures characterize the upper 1,000 feet of the buried crystalline rock at the Savannah River Plant of the U.S. Atomic Energy Commission. One pervades the entire rock mass, thereby making it a single hydraulic unit; however, fractures of this type are so minute that water movement through them is exceedingly slow. The other type, restricted to definite zones, consists of larger openings that transmit water at a faster rate. Some zones containing this type of fracture can be correlated between wells by hydraulic methods.—Author's abstract

8363 **Marine Technology Society.** Exploiting the ocean—Transactions of the 2d annual MTS conference and exhibit, June 27–29, 1966: Washington, D. C., Marine Technology Soc., 570 p., illus., tables, 1966.

During the past year national interest in the oceans has increased with particularly strong emphasis on economic resources. Just what turn the commercial and industrial enterprise will take is not clear, but this conference reveals the need for much better information about the location, distribution, and abundance of the resources and about the economic factors and technology of their removal, as well as clarification of legal aspects. This volume contains the papers presented at the conference; the four dealing with mineral resources are cited separately.—G.D.C.

Marovelli, R. L. *See* Chen, T. S. 8523

8751 **Martinez, E.** Chrysotile asbestos—Relationship of the surface and thermal properties to the crystal structure: Canadian Mining and Metall. Bull., v. 59, no. 655, p. 1305–1311, illus., 1966.

Chrysotile fiber, in contrast to other silicates including amphibole asbestos, has an electropositive charge which can be reversed by several methods. Chemical treatment affects the rate of filtration. These characteristics are related to crystal structure by X-ray, D.T.A., infrared absorption spectra, surface chemistry, and other methods.—A.R.K.

8793 **Masch, Frank D.; Denny, Kleber J.** Grain size distribution and its effect on the permeability of unconsolidated sands: Water Resources Research, v. 2, no. 4, p. 665–677, illus., table, 1966.

Experimental studies to investigate relationships between permeability and grain size parameters of porous mediums consisted of systematic variation of parameter values and evaluation of corresponding permeabilities. Measures were made of average size, dispersion, skewness, peakedness, and modality of the sample distributions; several graphs relate these to permeability. A group of curves, defined to predict laboratory permeability values for aquifer samples with random statistical distribution, incorporated only the average size and dispersion. These prediction curves were then used to determine the laboratory permeability coefficients for samples from a natural aquifer; results were compared with actual laboratory values.—G.D.C.

8411 **Masimer, George E.** Tick Canyon revisited: Gems and Minerals, no. 347, p. 20–23, illus., 1966.

The geology and collecting possibilities of the Lang mine of the Sterling Borax Co., located in Tick Canyon, near Lang, Calif., are reviewed. Minerals described are howlite, bakerite, veatchite, colemanite, calcite, celestite, analcime, selenite, probertite, ulexite, realgar, natrolite, and heulandite. Several are illustrated.—E.S.L.

8762 **Mather, Bryant.** Rock properties interpreted from sonic velocity logs—Discussion [of paper 4715 by R. D. Carroll, 1966]: Am. Soc. Civil Engineers Proc., v. 92, paper 4958, Jour. Soil Mechanics and Found. Div., no. SM 6, p. 254–255, 1966.

The data plotted in Figs. 4 and 5 of Carroll's paper should yield relationships that would be somewhat more instructive if the values for abscissas had been velocity squared.—E.S.L.

Mayeda, T. K. *See* Clayton, R. N. 8448

Maynard, G. L. *See* Kroenke, L. W. 8553

Maynard, G. L. *See* Furumoto, A. S. 8561

McCaleb, S. B. *See* Scull, B. J. 8476

8741 **McClellan, William A.** Arenaceous Foraminifera from the Waldron shale (Niagaran) of southeast Indiana: Bulls. Am. Paleontology, v. 50, no. 230, p. 447–518, illus., tables, 1966.

In a large and diversified Foraminifera fauna collected from the Waldron Shale in southeast Indiana and northern Kentucky, 16 genera and 33 species representing Astrohizidae, Saccamminidae, and Ammodiscidae, were recovered from 11 localities. Of these, one new genus, *Sorostomasphaera*, and seven new species are recognized; several species are recorded from the Silurian for the first time. Two *Hyperammina* were previously known only from the Mississippian, one *Webbinelloidea* from the Devonian, and *Hemisphaerammina bradyi* only as a Recent form. The Waldron Shale can be differentiated from other Silurian formations by foraminiferal assemblages and relative abundance of certain groups. The present fauna is dominated by the Saccamminidae whereas lower Silurian assemblages have more abundant Ammodiscidae.—G.D.C.

8572 **McCoy, F. W., Jr.** Submarine volcanism along the east rift zone of Kilauea, Hawaii [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Div. Mtg. Solid Earth Physics II, p. 29, 1966.

8689 **McDonald, Barrie C.** Surficial geology—Géologie des dépots meubles, Richmond–Dudswell, Québec: Canada Geol. Survey Prelim. Ser. Map 4–1966, scale 1:63,360, 1966.

McGlade, William G. *See* Lytle, William S. 8713

8375 **McGrain, Preston.** Daniel J. Jones (1889–1965): Am. Assoc. Petroleum Geologists Bull., v. 50, no. 7, p. 1526, portrait, 1966.

McIntosh, John S. *See* Ostrom, John H. 8664

8350 **McKee, Edwin D.** Significance of climbing-ripple structure, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550–D, p. D94–D103, illus., tables, 1966.

Climbing-ripple lamination (ripple drift structure) forms under relatively weak hydrodynamic conditions suitable for development of a rippled surface and where a very large amount of sand or silt is available. River flood plains and areas of overbank flow are particularly favorable, as illustrated by examples along the Colorado, Mississippi, and Indus Rivers, where climbing-ripple lamination commonly is associated with horizontal lamination, with a limited amount of trough and planar types of cross stratification and with contorted bedding of convolute and recumbent types. Some places where ripple marks are abundantly developed are largely devoid of climbing-ripple structure because new sand is not being introduced rapidly, whereas that on hand is constantly reworked and ripple marks are destroyed.—*from* Author's abstract

8498 **McKee, Edwin D.** Structures of dunes at White Sands National Monument, New Mexico (and a comparison with structures of dunes from other selected areas): Sedimentology, v. 7, no. 1, spec. issue, 69 p., illus., tables, 1966.

The type, scale, and relative abundance of sedimentary structures in dome-shaped, transverse, barchan, and parabolic dunes in this area were determined from wall sections of trenches cut through them at right angles and in a windward direction. Common features include medium to large-scale sets of cross-strata; downwind dip of laminae at high angles; bounding surfaces between sets nearly horizontal on upwind side, but steepening to lee; individual sets thinner and laminae flatter nearer the top than at bottom of dune. Sparse but distinctive features are described also. In terms of three dimensions, tabular planar sets are dominate with units thickest near the dune base. Dunes characteristic of one wind direction are compared with the multi-directional wind forms such as seif dunes of Libya, reversing dunes of Colorado, and star dunes in Saudi Arabia.—G.D.C.

8365 **McKelvey, V. E.; Chase, Livingston.** Selecting areas favorable for subsea prospecting, *in* Exploiting the ocean—MTS Conf. and Exhibit, 2d Ann., 1966, Trans.: Washington, D. C., Marine Technology Soc., p. 44–60, illus., 1966.

Improved submarine mining technology can find rich deposits of several minerals almost anywhere; the search for favorable submarine occurrences of several important minerals can be expensive. Geologic and oceanographic principles are adequate to define those related to upwelling nutrient-rich waters through knowledge of oceanic circulation; and residual mineral provinces, from analyses of local source terrane, climate, geomorphology, and tectonics. A third group, such as localized hot-springs deposits of manganese and iron sulfides may require a knowledge of submarine volcanism. It would be desirable to extend systematic geologic mapping and related geophysical surveys over the continental shelves. G.D.C.

8410 **McKenzie, Dan P.** The viscosity of the lower mantle: Jour. Geophys. Research, v. 71, no. 16, p. 3995–4010, table, 1966.

Until recently the processes causing creep in solids under the low stresses present within the Earth were obscure, and there were no estimates of the viscosity of the lower mantle. In this paper the use of a stress-independent viscosity is justified, and the Navier–Stokes equation is applied to creep within the mantle, to investigate

how this viscosity may vary with depth within the Earth and to estimate the viscosity of the lower mantle from the nonhydrostatic equatorial bulge. The viscosity is shown to the 6×10^{26} (stokes), and this high value prevents both convection in the lower mantle and polar wandering.—*from* Author's abstract

8812 **McLaren, A. D.** The biochemistry of terrestrial soils, Chap. 7 *in* Biology and the exploration of Mars: Natl. Acad. Sci.—Natl. Research Council Pub. 1296, p. 147–163, tables, 1966.

Compounds characteristic of life, such as enzymes and nucleic acids exist in nearly undetectable amounts in Earth soils. Athough nutritional requirements of organisms in strange soils may be unknown, it is assumed the enzyme constituents released by decomposed organisms are universal in general properties. Relative abundance of extracellular compounds in the complex graveyard of microorganisms is far from that found in living tissues. Some of what is known about biochemical reactions in soil and the nature of its organic matter is described. Soils with greater humus or clay content hold more water than silt; but waterlogged they have no air spaces, and dry have only water films. A microbiological fractionation of isotopes might be useful in life detection; both calorimetric and free radical measurements appear to be important.—G.D.C.

8800 **McRae, Otis M.** General geology and some structural features of the Courtland–Gleeson area, Cochise County, Arizona: Soc. Mining Engineers Trans., v. 235, no. 2, p. 133–138, illus., table, geol. map, 1966.

The Courtland–Gleeson area is about 15 mi east of Tombstone. Exposed rocks range from Precambrian to Quaternary; a summary description is given in a table. All rocks as old as early Tertiary have been involved in either tilting, normal faulting, high angle reverse faulting, imbricate thrusting, or folding and overfolding. The major structure is the Dragoon thrust, but four other thrusts and two gravity slide faults are described also. Following early Tertiary quartz latite emplacement, northeast–southwest compressional forces caused thrust plates containing lower Paleozoic rocks to override Cretaceous rocks. Later normal faulting dislocated thrust plates, and large rock masses slid eastward by gravity.—E.S.L.

Meents, W. F. *See* Clayton, R. N. 8448

8524 **Meeves, Henry C.** Nonpegmatitic beryllium occurrences in Arizona, Colorado, New Mexico, Utah, and four adjacent states: U.S. Bur. Mines Rept. Inv. 6828, 68 p., illus., tables, 1966.

Twenty-four of 155 mining properties examined had rock containing more than 0.10 percent BeO, based on field and laboratory analyses by the nuclear beryllium–detection technique, which is explained in detail. Descriptions are given for the most significant deposits; results from all the properties are tabulated in an appendix. Low-grade nonpegmatitic ore in Utah responds favorably to small-scale treatment processes and constitutes a large resource that may reduce the dependence of the U.S. on imported beryl.—H.R.B.

8504 **Mefferd, M. G.** Newhall–Potrero oil field: California Div. Oil and Gas, California Oil Fields—Summ. Operations 1965, v. 51, no. 2, p. 41–51, illus., tables, 1966.

The subsurface structure of the Newhall–Potrero oil field is an asymmetrical, northwesterly plunging, faulted anticline; the most significant fault is upthrown from the south and occurred prior to the folding. Formations logged range from upper Miocene to Recent. The Pico Formation (upper Pliocene), exposed at the surface over practically the entire field, averages about 6,100 feet thick. To date only 5,000 feet of the Modelo Formation (upper Miocene) has been penetrated, but the formation contains the seven major producing zones.—M.C.M.

8833 **Meinschein, Warren G.; Frondel, Clifford; Laur, Peter; Mislow, Kurt.** Meteorites—Optical activity in organic matter: Science, v. 154, no. 3747, p. 377–380, illus., tables, 1966.

A low-amplitude, positive, Cotton effect, centered at about 340 millimicrons, has been observed in organic extracts of samples from ordinary (noncarbonaceous) chondrites. Ancillary evidence renders it likely that this optical activity derived from contamination by biologic materials on Earth.—Authors' abstract

8663 **Meisler, Harold; Becher, Albert E.** Hydrology of the carbonate rocks of the Lancaster 15-minute quadrangle, Pennsylvania: Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 171, 36 p., illus., tables, 1966.

Limestone and dolomite strata of Cambrian and Ordovician age underlie the lowland which occupies about 60 percent of the quadrangle and contains several anticlinal ridges underlain by Lower Cambrian. Ground water in the carbonate rocks occurs within bedding and cleavage planes, and in joints, faults, and fractures. Specific capacities of wells in valleys are greater than for those on ridges, and shallow wells have a greater capacity than deep ones. Ground water is of the calcium bicarbonate type with 90 percent of the wells having more than 270 ppm hardness. Chemical analyses are tabulated, and a record of wells and springs included. A map showing carbonate rock areas, and location of wells and springs accompanies the report.—E.S.L.

8820 **Melik, James C.; Weiss, Martin.** Hingement and contact margin structure of palaeocopid ostracodes from some Middle Devonian formations of Michigan, southwestern Ontario and western New York: Michigan Univ. Mus. Paleontology Contr., v. 20, no. 8, p. 195–269, illus., 1966.

The hinge and contact margin structure have been worked out on many Middle Devonian palaeocopid ostracodes from examination of a large number of single valves and of acetate peels prepared from complete carapaces. Peel series have also revealed other important features of shell morphology. Five types of hinge structure were found to be represented in the Middle Devonian palaeocopid ostracodes. The peel technique is described. Descriptions of three new species [of *Hollinella*] are included.—*from* Authors' abstract

8546 **Mellen, F. F.** Jurassic exploration warms Southeast: Oil and Gas Jour., v. 64, no. 51, p. 96–100, 1966.

Of the seventeen oil fields producing from Upper Jurassic of Mississippi, all but four were discovered after 1962. The Upper Jurassic formations in Mississippi, a continuation of rocks of the same age from Mexico across Texas, Arkansas, and Louisiana, in ascending order are: Norphlet, Smackover, Buckner, and Cotton Valley. The most important formations are the Smackover, which contains porous sandstone, and oolitic, dolomitic, vuggy, or fractured limestone, and the Cotton Valley which contains porous blanket sandstone such as the Bay Springs sand. The Bay Springs field was drilled on a reflection seismograph prospect on a gravity minimum. The approximate producing depth is 14,500–14,560 feet, the porosity of the reservoir rock is 18 percent, and the API gravvity is 48°.—K.A.D.

8470 **Meltzer, Lee H.** Geology of West Bastian Bay field, Plaquemines Parish, Louisiana [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2323, 1966.

Merifield, P. M. *See* Lamar, D. L. 8884

8827 **Merino y Coronado, J.** ¸Nuevo instrumental—Un sismómetro vertical con suspensión magnético [also English text]: Geofísica Internac., v. 6, no. 1, p. 33–38, illus., 1966.

Vertical seismometers are based on a pendulum system made of a mass hanging from a coil spring to eliminate the dissymmetry of oscillatory movements, with an elastic diaphragm or plates or threads acting as a transducer. If the spring constant is large, the system functions as an accelerograph, while if it is small, it can be used to measure displacements. Changes in temperature and atmospheric pressure cause difficulties with this type of seismometer, and the author has built one (described and illustrated) using magnetic suspension instead of a spring.—E.S.L.

8366 **Mero, John L.** Review of mineral values on and under the ocean floor, *in* Exploiting the ocean—MTS Conf. and Exhibit, 2d Ann., 1966, Trans.: Washington, D. C., Marine Technology Soc., p. 61–78, tables, 1966.

For consideration of mineral deposits, the ocean can be divided into several regions: beaches, seawater, continental shelf, deep-sea floor, and sub-sea floor rocks. Mineral reserves of placers on off-shore beaches have never been defined adequately, but are estimated to be several times those of known onshore beaches. A recently developed technique may make seawater a potential unlimited source of many minerals. Phosphate reserves of the shelf are estimated in excess of 200 billion tons. The sub-sea floor rocks contain various sedimentary deposits and other minerals in veins as on land. On the deep-sea floor are essentially unlimited metals and other mineral deposits, which are forming at rates greatly in excess of present day world consumption.—G.D.C.

8756 **Meyer, Richard F.** Geology of Pennsylvanian and Wolfcampian rocks in southeast New Mexico: New Mexico Bur. Mines and Mineral Resources Mem. 17, 123 p., illus., tables, geol. maps, 1966.

Rocks of southeastern New Mexico are subdivided on the basis of biostratigraphic zones traceable over the entire area; fusulinids upon which correlations are based are listed by age. Stratigraphy of the Morrowan, Derryan, Desmoinesian, Missourian, and Virgilian Stages of the Pennsylvanian, and the Permian Wolfcampian Stage is discussed, and supercrop, subcrop, isopach, isolith, and lithofacies maps and four cross sections are given. In the Permian basin, sedimentation was continuous, but to the west an unconformity separates Pennsylvanian from Wolfcampian. Major structural features are the Pedernal uplift and Central Basin platform, showing compressional folding and uplift followed by normal or high-angle reverse faulting. Oil and gas production trends for each stage are reviewed and chemical analyses of waters and crude oil discussed.—E.S.L.

8449 **Miller, Robert L.; Byrne, Robert J.** The angle of repose for a single grain on a fixed rough bed: Sedimentology, v. 6, no. 4, p. 303–314, illus., tables, 1966.

The angle of repose under water is experimentally determined for a single particle on a fixed rough bed. The effect of grain shape, size and sorting of the bed and ratio of particle diameter to average bed grain diameter are taken into account. An empirical equation is given for predicting angle of repose as a function of the above factors. The accuracy of fit of this equation is quite good. Several other conclusions drawn for the case of a single grain on a fixed rough bed are: (1) Angle of repose increases with decrease in size, departure from sphericity and increased angularity, (2) angle of repose increases with decrease in sorting, and (3) a single angle of repose for sand size grains is not valid. Variation ranges from nearly 90° to less than 20°, depending on the values of the factors given above.—Authors' summary

8819 **Miller, S. L.; Horowitz, N. H.** The origin of life, Chap. 2 *in* Biology and the exploration of Mars: Natl. Acad. Sci.—Natl. Research Council Pub. 1296, p. 41–69, tables, 1966.

Experimental synthesis of organic compounds under primitive Earth conditions indicate that many of the large quantities of synthesized compounds do occur in living organisms. It may be implied that the first living organism was constructed from the predominant organic compounds in the primitive oceans, availability and usefulness determining the basic constituents of organisms on the Earth. Under similar conditions of origin, the basic components of life on Mars should be the same as those on Earth; the uncertainty is in whether there was sufficient water initially and sufficient time for life to start before this water escaped.—G.D.C.

8359 **Miller, Thomas P.; Patton, William W., Jr.; Lanphere, Marvin A.** Preliminary report on a plutonic belt in west-central Alaska, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D158–D162, illus., table, 1966.

Preliminary studies of a belt of plutons in west-central Alaska indicate that the plutons are divisible into an older, 100-m.y.-old suite composed chiefly of saturated

to undersaturated monzonite and syenite and a younger 81-m.y.-old suite chiefly of granodiorite and quartz monzonite. The older plutons occur in the western half of the plutonic belt and the younger plutons in the eastern half.—Authors' abstract

8866 **Milne, W. G.; Davenport, A. G.** Statistical parameters applied to seismic regionalization, *in* World Conf. Earthquake Eng., 3d, New Zealand, 1965, Proc., V. 1: Wellington, New Zealand Inst. Engineers, p. III-181—III-194, illus., tables, 1965 [1966].

Previous studies on the seismicity of a small area of western Canada include a plot of the epicentres of all earthquakes between 1951 and 1962; a strain-energy release study; and a computation of the formula relating magnitude and frequency of occurrence of the earthquakes. The extreme value theorem of statistics is applied to the same data to calculate a) the maximum magnitude of an earthquake expected in an area with a certain return period, and b) the maximum ground motion expected at selected points within an area with a certain return period. The parameters of this computation are shown to be of use in evaluating the seismicity of an area.—Authors' abstract

8467 **Minihan, Edward D.; Oxley, Marvin L.** Pre-Cretaceous geology of Pool Creek Field, Jones County, Mississippi [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2320, 1966.

Mirza, M. B. *See* Ehrlinger, H. P., 3d. 8501

Mislow, Kurt. *See* Meinschein, Warren G. 8833

8668 **Mock, Steven J.** Fluctuations of the terminus of the Moltke Glacier: U.S. Army Materiel Command, Cold Regions Research and Eng. Lab. Tech. Rept. 179, 5 p., 1966; revised [with French and German abs.], Jour. Glaciology, v. 6, no. 45, p. 369-373, 1966.

The terminus position of the Moltke Glacier has been mapped from existing maps and from aerial and terrestrial photographs for the years 1946-47, 1954, 1956, 1962, and 1965. With earlier work by J. W. Wright (1939), a fairly detailed record of terminus position exists for the period 1916 to 1965. The glacier has been in nearly continuous retreat during this period interrupted by a slight advance from 1926 to 1932. Loss of area has been accelerating since 1946-47. Ice flow velocity near the terminus has fluctuated through a known range from 30 meters per year to over 1,000 meters per year.—Author's summary

8716 **Moodie, C. D.; Okazaki, R.; Smith, H. W.; Kittrick, J. A.** A note on the clay mineralogy of four samples from the Ringold Formation: Northwest Sci., v. 40, no. 2, p. 43-45, table, 1966.

Clay minerals identified in four samples of the unconsolidated sediments of the Pleistocene Ringold Formation from the White Bluffs area of the Columbia River in Washington, are tabulated. Three samples were similar, with montmorillonite dominant and with associated illite, chlorite, and kaolinite. The fourth had montmorillonite as the only mineral. The presence of the montmorillonite explains the suitability of this formation for lining irrigation canals.—E.S.L.

8895 **Moore, J. E.; Jenkins, C. T.** An evaluation of the effect of groundwater pumpage on the infiltration rate of a semipervious streambed: Water Resources Research, v. 2, no. 4, p. 691-696, illus., 1966.

In at least one reach of the Arkansas River in southeastern Colorado, pumping has lowered the water table below the level of the apparently pervious streambed, breaking the connection between the stream and the water table. The river is gaining except where withdrawals from the valley fill are large. A large cone of depression extends as much as 12 feet below streambed in the losing reach without appreciable distortion. The major control on infiltration loss, where connection is broken, is probably the permeability of the least permeable layer of the streambed. In a bed with wide range of grain size and sorting, studies suggest small infiltration rates

if streambeds are undistributed and depth of water in stream is less than a foot.—G.D.C.

8360 **Moore, James G.** Rate of palagonitization of submarine basalt adjacent to Hawaii, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550–D, p. D163–D171, illus., tables, 1966.

Dredge hauls of pillow basalt from three Hawaiian volcanoes and from a sublake flow in Japan indicate that palagonitization of submarine basaltic glass proceeds faster than that in fresh water, and much faster than hydration of obsidian in a subaerial environment. The thickness of palagonite as a function of time (T) in kiloyears (ky) may be defined by: S = square root of CT, where S is thickness in microns (μ), and C is a constant. The value of C ranges from 480 to 2,000μ^2/ky for Hawaiian submarine basalt glass. During replacement of basaltic glass by palagonite, Na, Ca, and Mn are lost, and K, Ti, and Fe are gained. The resultant chemical zoning of a palagonitized basalt pillow resembles that found in ancient metamorphosed basalt pillows and suggests that their zoning is due to palagonitization which occurred prior to metamorphism.—Author's abstract

Morales, Gustavo A. *See* Peck, Raymond E. 8782

8469 **Morelock, Jack; Bryant, William R.** Physical properties and stability of continental-slope deposits, northwest Gulf of Mexico [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2325, 1966.

8419 **Morgan, J. W.; Heier, K. S.** Uranium, thorium and potassium in six U.S.G.S. standard rocks: Earth and Planetary Sci. Letters, v. 1, no. 4, p. 158–160, table, 1966.

Andesite AGV–1, basalt BCR–1, dunite DTS–1, granite G2, granodiorite GSP–1 and peridotite PCC–1 have been analyzed in the laboratory of the Department of Geophysics and Geochemistry, Australia National University, using the techniques of gamma-ray spectrometry, flame photometry and neutron activation analysis. Levels of U, Th, and K in dunite and peridotite were below limits of detection for routine operation. For the other four rocks measured by gamma-ray spectrometry, potassium abundances were determined also by flame photometry; all results are in excellent agreement. Because of high thorium abundance in granodiorite no neutron activation analysis was made; otherwise uranium and thorium results by gamma-ray spectrometry and by neutron activation agree well except for granite.—G.D.C.

8507 **Morimoto, N.; Kullerud, G.** Polymorphism on the Cu_5FeS_4–Cu_9S_5 join [with German abs.]: Zeitschr. Kristallographie, v. 123, nos. 3–4, p. 235–254, illus., tables, 1966.

Because bornite and digenite are often found together in ore deposits, the subsolidus phase relations of this join are of interest in understanding their genesis. Homogeneous solid solutions on nine compositions were synthesized and their crystallographic properties studied by the Weissenberg and precession methods at various temperatures. At elevated temperatures each exists as one phase, and at subsolidus temperatures two phases occur. When studied over a temperature range, all display X-ray reflections analogous to high-, transitional-, and low-temperature bornite and digenite. The structure of these temperature forms is described. The transitional metastable forms appear temporarily during the inversion from high- to low-temperature polymorph, and are superstructures of the former. Results of experiments carried out on natural bornite and digenite are explained on the basis of the transitional forms.—E.S.L.

Mourant, Walter A. *See* Berkstresser, Charles F., Jr. 8769

8875 **Mundorff, James C.** Sedimentation in Brownell Creek subwatershed No. 1, Nebraska: U.S. Geol. Survey Water-Supply Paper 1798–C, p. C1–C49, illus., tables, 1966.

This report describes and interprets the results of investigations of sedimentation in the 495-acre subwatershed, including investigations of the trap efficiency of two reservoirs. Information on the following subjects are presented: sediment discharge from the reservoirs; particle-size distribution of sediment transported into, deposited in, and discharged from the reservoirs; runoff in the watershed; and trap efficiencies of the reservoirs.—W.L.G.

Murphy, Z. E. *See* DeCarlo, J. A. 8735

8512 **Musgrave, A. W.; Hicks, W. G.** Outlining of shale masses by geophysical methods: Geophysics, v. 31, no. 4, p. 711–725, illus., 1966.

Shale masses are defined as large bodies of shale several hundred feet in thickness, formed either by diapirism or by deposition. Compared to the normal section, shale masses exhibit low velocities, low resistivities, and high fluid pressures, all of which seem to be due to the high porosity and low permeability. These physical properties allow the outlining of a shale mass by one or more of the following ways: gravity surveys, to outline the low-density material; reflection surveys, to outline the lack of reflection contrast and in some cases map velocity configuration; refraction surveys, to indicate the velocity of the anomalous mass and thus differentiate between shale and salt.—D.B.V.

Musgrave, B. C. *See* Gunter, B. D. 8667

Myers, W. Bradley. *See* Hamilton, Warren. 8547

8374 **Nagel, Fritz G.** Stanley Battershill White (1899–1965): Am. Assoc. Petroleum Geologists Bull., v. 50, no. 7, p. 1526–1527, portrait, 1966.

Naughton, J. J. *See* Barnes, I. L. 8578

8579 **Naughton, J. J.; Barnes, I. L.; Lennon, K.** Lava lake gases—Absorption spectra and equilibria [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Div. Mtg. Solid Earth Physics II, p. 40, 1966.

Neal, D. W. *See* Young, L. L. 8886

8361 **Nelson, A. E.** Significant changes in volcanism during the Cretaceous in north-central Puerto Rico, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D172–D177, illus., table, 1966.

During Late Cretaceous time in north-central Puerto Rico the environment of deposition changed from marine to mostly subaerial. Chemical analyses show continuous variation in the composition of Cretaceous volcanic rocks. The submarine volcanic rocks are mostly basalt and andesite; most of the later subaerially deposited rocks are dacite and rhyolite.—Author's abstract

8807 **Nelson, Arthur E.** Cretaceous and Tertiary rocks in the Corozal quadrangle, northern Puerto Rico: U.S. Geol. Survey Bull. 1244-C, p. C1–C20, illus., table, 1966.

In the Corozal quadrangle, 11,600 m of Cretaceous and lower Tertiary volcanogenic deposits are present. These are unconformably overlain, in the northern part of the quadrangle, by 470 m of middle Tertiary marine deposits. Faulting has divided the Cretaceous and lower Tertiary rocks into three sequences whose relative stratigraphic relations are obscure. The Rio Orocovis Formation of earlier workers has been raised to group rank and its members to formation rank. In addition, the following Cretaceous and Tertiary stratigraphic units are defined or named: Cuchillas Member (of the Avispa Formation), Cibuco Formation, Palmarejo Formation, Corozal Limestone, Ortiz Formation, and the Mucarabones Sand. A.E.N.

Nelson, C. A. *See* Stewart, John H. 8341

Nelson, Carl W. *See* Gordon, Robert B. 8552

8570 **Nelson, J. H.; Kuberry, R.** Preliminary results from a triple-sensor rubidium-vapor magnetometer [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Div. Mtg. Solid Earth Physics II, p. 5, 1966.

8364 **Nelson, T. W.; Burk, C. A.** Petroleum resources of the continental margins of the United States, *in* Exploiting the ocean—MTS Conf. and Exhibit, 2d Ann., 1966, Trans.: Washington, D. C., Marine Technology Soc., p. 116–133, illus., 1966.

Estimates of the petroleum potential of these shelves reflect poor understanding of geologic structure and history of offshore areas and difficulty of guessing amounts of undiscovered resources. Approximately 2 billion bbls oil and 5 1/2 trillion cubic feet of gas have been produced from a small part; another 3 1/2 billion bbls and 22 3/4 trillion cubic feet proved by drilling; 3 billion bbls and 27 trillion cubic feet are in known reservoirs; and possibly 8 to 26 billion bbls and 33 to 113 trillion cubic feet remain to be discovered. The ultimate potential may range from 15 to 35 million bbls of petroleum liquids, and from 90 to 170 trillion cubic feet of natural gas. To date more than 8,250 offshore wells have been drilled.—G.D.C.

8346 **Newcomb, R. C.** Lithology and eastward extension of the Dalles Formation, Oregon and Washington, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D59–D63, illus., table, 1966.

The Dalles Formation consists of the uneroded part of a low cone of volcanic agglomerate deposited northward and northeastward and an interfingering sedimentary facies of tuff, siltstone, and conglomerate deposited by westward-flowing rivers. The sedimentary facies was mapped eastward to Rufus, Oreg., and similar deposits bearing other names were seen in an eastward reconnaissance as far as the vicinity of McKay Reservoir, Oreg., about 120 miles east of The Dalles. Name and age changes may be necessary as this Pliocene stratigraphy becomes clarified.—Author's abstract

8676 **Newton, J. G.; Toulmin, L. D.** Profile showing geology along U.S. Highway 31 from Logan, Lowndes County, to McKenzie, Butler County, Alabama: Alabama Geol. Survey Map 41, 1 sheet, text, 1966.

The strike of beds in the profile area is northwestward; the direction of the profile is about parallel to the regional dip, generally 30–40 feet per mile. Units exposed from north to south are: Cretaceous Ripley Formation and Providence Sand; Paleocene Clayton and Porters Creek Formations; Eocene Nanafalia Formation, Tuscahoma Sand, and Hatchetigbee, Tallahatta, and Lisbon Formations; and Pleistocene and Recent alluvium and terrace deposits. Principal or potential sources of large supplies of ground water are the Ripley, Clayton, Porters Creek, and Nanafalia Formations. Brown iron ore is mined from the top of the Clayton and the upper half of the Porters Creek Formation. Most Paleocene and Eocene formations are potential sources of clay; high calcium-carbonate limestone occurs in the Clayton Formation; and sand has been quarried from most formations. M.C.M.

Niggli, A. *See* Donnay, J. D. H. 8508

8446 **Nix, Joe Franklin.** A neutron activation analysis of uranium in stone meteorites [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 711B, 1966.

8576 **Noguchi, K.; Ueno, S.; Noguchi, Ko.** Geochemical studies of hot springs in Yellowstone National Park [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Div. Mtg. Solid Earth Physics II, p. 37, 1966.

8577 **Noguchi, K.; Ueno, S.; Noguchi, K.** Geochemical studies on the volcanic gases and hot springs in Lassen Volcanic National Park [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Div. Mtg. Solid Earth Physics II, p. 38, 1966.

Noguchi, K. *See* Noguchi, K. 8577

Noguchi, Ko. *See* Noguchi, K. 8576

Norris, R. A. *See* Johnson, R. H. 8563

8845 **Norris, Stanley E.; Fidler, Richard E.** Effect of sampling and testing methods on computed hydraulic properties of glacial outwash at Piketon, Ohio, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D228-D230, tables, 1966.

Particle-size distribution and permeability were determined in the laboratory for samples from two adjacent test holes, one drilled with an auger and the other "bailed in" with cable-tool equipment. Discrepancies in the logs and in analytical values obtained in the laboratory for samples from the same reported depths in these holes are believed to be inherent in the drilling methods. For both sets of samples, transmissibility computed from laboratory results is far less than the value determined from a pumping test. Laboratory and pumping-test values probably are not equatable unless flow direction with respect to bedding is the same. Authors' abstract

8808 **Norton, James J.** Ternary diagrams of the quartz-feldspar content of pegmatites in Colorado: U.S. Geol. Survey Bull. 1241-D, p. D1-D16, illus., table, 1966.

Modes of 1,803 pegmatites of the Quartz Creek district, Gunnison County, Colo., and 1,301 pegmatites of the Crystal Mountain district, Larimer County, Colo., have been plotted on ternary diagrams. Average compositions are similar to those of granites. A wide range in the proportions of Or to Ab, especially in layers of layered pegmatites and zones in zoned pegmatites, is attributed to separation of potassic from sodic material by transport through a hydrous gas during crystallization of pegmatitic magma. The final products of crystallization of many pegmatites are nearly monomineralic quartz units that are in sharp contrast with the more abundant feldspathic varieties of pegmatite.—J.J.N.

8744 **Oakeshott, Gordon B.; Wahrhaftig, Clyde.** A walker's guide to the geology of San Francisco: California Div. Mines and Geology Mineral Inf. Service, v. 19, no. 11, spec. supp., p. S1-S31 (between p. 176 and 177), illus., 1966.

The description of the geologic setting of the San Francisco Bay area was prepared by the senior author (portions reprinted from Geotimes), and the walker's guide to the geology of the city was compiled by the co-author, especially for visiting members of the Geological Society of America during its 1966 meeting in San Francisco. Areas of interest included in the guide are: Franciscan graywacke and shale of Russian Hill-Aquatic Park and Telegraph Hill; petrology of downtown and the Civic Center buildings; subsidence due to fill on tidal marshes along Fifth Street and between Clara and Tehama Streets; chert and serpentine in Corona Heights; landslide at Ocean Beach and Lands End; Pliocene-Pleistocene features between the Zoo and Muscle Rock; late Pleistocene in the Point Lobos area; and a metamorphic outing on Angel Island in the Bay.—G.D.C.

O'Connor, J. T. *See* Lipman, P. W. 8796

Okazaki, R. *See* Moodie, C. D. 8716

8678 **O'Leary, Mont; Lippert, R. H.; Spitz, Owen T.** FORTRAN IV and map program for computation and plotting of trend surfaces for degrees 1 through 6: Kansas Geol. Survey Computer Contr. 3, 48 p., illus., tables, 1966.

A program description includes a listing of FORTRAN IV statements in the trend-surface program. A section on input data preparation covers control and input cards and a sample data set for structure on top of the Arbuckle Group. The output from this data is explained, including error messages, and three stages of the map are shown.—E.S.L.

8349 **Olive, Wilds W.** Lake Paducah, of Late Pleistocene age, in western Kentucky and southern Illinois, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D87–D88, illus., 1966.

A Pleistocene lake in western Kentucky and southern Illinois, herein named Lake Paducah, has been dated by the radiocarbon method as late Pleistocene (Wisconsin). The date, obtained from mollusk shells in a deposit of sandy silt, is 21,080±400 years B.P. (sample W-1353).—Author's abstract

8665 **Oliver, William A., Jr.** Description of dimorphism in *Striatopora flexuosa* Hall: Palaeontology, v. 9, pt. 3, p. 448–454, illus., 1966.

Striatopora Hall comprises branching favositoid tabulate corals with thick, dilated walls near the outer surface of colonies. Study of serial sections of type species, *S. flexuosa* Hall, shows that individuals commonly originated either near the axis of the colony or near the boundary between inner thin-walled and outer thick-walled zones. Corallites in the two positions are morphologically distinct and were produced alternately by corallites of the first type. Previous descriptions of *S. flexuosa* have been based on exteriors of colonies or on other than type specimens. Redescription of type specimens based on thin section studies provides a better basis for understanding the genus. Other named genera of morphologically comparable corals can be differentiated by wall microstructure or other features, or are possible subjective synonyms of *Striatopora*.—*from* Author's abstract

8535 **Orowan, E.** Dilatancy and the seismic focal mechanism [discussion of "On dilatancy in relation to seismic sources," by F. C. Frank, 1965]: Rev. Geophysics, v. 4, no. 3, p. 395–404, illus., 1966; discussion of reply by F. C. Frank, 1966, ibid., p. 409, 1966.

A more complete calculation of the seismic focal stress drop than that given by Frank (ibid., v. 3, p. 485–503, 1965) "shows that instability attributed to dilatancy is a familiar general property of compacted granular masses independent of dilatancy. The rapid propagation of the seismic fault attributed to shear melting by elastic energy release would depend on the assumed absence of friction between the walls of an initial Griffith crack. Since the length of the thin Griffith crack was estimated at 5 km, friction could be absent only if the crack were filled with a pore fluid of pressure equal to the total pressure; in this case the shear strength would be zero and seismic shocks could not arise." In discussion of Frank's reply, Orowan disagrees with Frank's suggestion that the point at issue is a semantic one.—V.S.N.

8776 **Osborne, F. Fitz; Riva, John.** Post-Levis beds of the Quebec Group at St. Apollinaire, Lotbinière Co., P.Q. [with French abs.]: Naturaliste Canadien, v. 93, no. 2, p. 145–151, illus., tables, 1966.

Beds lithologically similar to those of the upper part of the Levis Formation [Lower Ordovician] but with a hitherto locally unrecognized *Glyptograptus teretiusculus* fauna crop out north of St. Apollinaire. West of the village, very richly fossiliferous rocks are exposed along Bourret brook. They have a fauna similar to that of but are lithologically unlike the [Middle Ordovician] Normanskill beds of New York.—Authors' abstract

8779 **Osborne, F. Fitz; Berry, W. B. N.** Tremadoc rocks at Levis and Lauzon [with French abs.]: Naturaliste Canadien, v. 93, no. 2, p. 133–143, table, 1966.

Part of the section of the Levis formation with abundant limestone conglomerates has probably been rendered more competent than other sections, thus giving rise to the relatively simple structure at Lauzon and Levis. Most of the conglomerates are below the "A" zone of Raymond and are possibly Tremadoc [as indicated by graptolite faunas]. Still lower beds in Lauzon [containing dendroid graptolites] are probably Upper Cambrian. Fossils in sections at other localities show the rapid change in lithofacies in the Levis; even the conglomerates may be absent at levels where they are abundant at nearby localities.—Authors' abstract

Osterwald, Frank W. *See* Tibbetts, Benton L. 8355

8664 **Ostrom, John H.; McIntosh, John S.** Marsh's dinosaurs—The collections from Como Bluff: New Haven, Conn., Yale Univ. Press, 388 p., illus., 1966.

Como Bluff, an obscure little hill in southeastern Wyoming, is the site of one of the greatest assemblages of giant and small dinosaurs and of minute Jurassic mammals ever to be found. Discovered in 1877, these collections form the nuclei of the world-famous paleontologic collections in Yale's Peabody Museum and the National Museum in Washington, D. C. This volume includes an illustrated historical sketch of the early years of Como Bluff; faunal lists of its quarries, of Lake's quarries at Morrison, Colo., and of Felch's Quarries at Garden Park, Colo.; and numerous plates illustrating species of Marsh's Sauropoda and Stegosauridae. Also included is an annotated bibliography of fossil vertebrates from Como Bluff.—G.D.C.

Oxley, Marvin L. *See* Minihan, Edward D. 8467

8406 **Özkol, Sedat.** Swelling characteristics of Permian clay [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 813B, 1966.

8405 **Paduana, Joseph Anthony.** The effect of type and amount of clay on the strength and creep characteristics of clay-sand mixtures [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 813B, 1966.

8484 **Paine, William R.** Stratigraphy and sedimentation of Hackberry shale (Middle Oligocene) and associated beds of southwestern Louisiana [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2324, 1966.

8500 **Paone, James; Tandanand, Sathit.** Inelastic deformation of rock under a hemispherical drill bit: U.S. Bur. Mines Rept. Inv. 6838, 26 p., illus., tables, 1966.

The study concerns the primary phase of crater formation, that is, before chip formation takes place. Rock strength is considered from the Mohr-Coulomb criterion, from which a surface of failure is constructed. The results of previous triaxial tests on Solenhofen limestone verify the criterion of failure. Inelastic behavior of limestone and basalt was observed under low-velocity impact and static indentation. Permanent set at low applied loads in the indented area was measured with an interferometer technique. Quantitative determinations of strengths of Solenhofen limestone, Indiana limestone, and Tennessee marble were made under static indentation. Maximum yield strength estimated from average stress over the indented area is used as the crushing strength of rock under a drill bit.—H.R.B.

Papadopulos, Istavros S. *See* Bredehoeft, John D. 8896

8562 **Pararas-Carayannis, George; Furumoto, A. S.** The generating area and source mechanism of the Alaskan tsunami [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Div. Mtg. Solid Earth Physics I, p. 35, 1966.

8531 **Pariseau, W. G.** A new view of the ideal plasticity of soils and unconsolidated rock materials: Internat. Jour. Rock Mechanics and Mining Sci., v. 3, no. 4, p. 307-317, 1966.

The theory of soil plasticity is reviewed and is shown to be inconsistent with the assumption of isotropy when the equation of the yield envelope is taken as the plastic potential. A new view, considering the effects of shear and compression as separate but related phenomena, is presented.—Author's abstract

8393 **Parker, J.** Mining in a lateral stress field at White Pine: Canadian Mining and Metall. Bull., v. 59, no. 654, p. 1189-1197, 1966.

The original design of mine openings and pillars at the White Pine Copper Co. was based upon traditional assumptions; i.e., that the principal load is due to the weight of overburden, and that horizontal stresses are equal to one-third of the

vertical. Beginning in January, 1964, borehole deformation measurements confirmed suspicions that the principal stress is horizontal and several times greater than the vertical. Vertical stress appears to be directly related to depth, but lateral stresses vary considerably in direction and magnitude. In this paper, rock failures are illustrated, methods of measurement and typical results are given, and measures to counter or utilize the lateral stresses are described.—Author's abstract

8382 **Parker, J. William; Roberts, J. W.** Regional Devonian and Mississippian stratigraphy, central Colorado Plateau: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 11, p. 2404–2433, illus., table, 1966.

Devonian and Mississippian rocks cover most of the central part of the Colorado Plateau. The Devonian rests on Cambrian rocks and the contact is a disconformity. The three major units of the Devonian in ascending order are the Aneth, Elbert, and Ouray Formations; the Ouray is both Devonian and Mississippian. The major unit of the Mississippian is the Redwall Formation.—A.E.R.

Parry, L. G. *See* Dickson, G. O. 8418

8771 **Parsons, James D.** Piling difficulties in the New York area: Am. Soc. Civil Engineers Proc., v. 92, paper 4617, Jour. Soil Mechanics and Found. Div., no. SM 1, p. 43–64, illus., 1966.

There are large areas in Manhattan and other boroughs where bedrock is at great depths, and pile support of structures is required. The diverse and complex soil and foundation conditions are closely related to the area's geologic and glacial history, including its immediate proximity to the terminal moraine and the presence of two glacial lakes. Variable depths of sand, varved silt, and till overlie the rock in the glacial lake areas. The bedrock varies in degree of weathering, and its surface topography poses serious problems. Five case histories using piles are discussed; typical geologic sections and driving records are given for each.—E.S.L.

8529 **Parsons, R. C.; Hedley, D. G. F.** The analysis of the viscous property of rocks for classification: Internat. Jour. Rock Mechanics and Mining Sci., v. 3, no. 4, p. 325–335, illus., tables, 1966.

For rock classification purposes, several specimens from each of twenty different rock types have been tested in uniaxial compression to determine the magnitude of the viscous component. Several methods of evaluating the results to determine the magnitude of the viscous coefficients are discussed and compared. Two basic methods use extrapolation or the shape of the time-deformation curves. It was found that for the great majority of rock types tested, the semi-log relationship, log time vs. strain, closely fits the data. Extrapolation to the region of 200 min gives a realistic value of the strain rate. The strain rate of 2μ in/in/hr appears to be a practical value for the division between elastic and viscous behaviour of rock.—*from* Authors' abstract

Parsons, Roger B. *See* Reckendorf, Frank F. 8717

8814 **Paschal, E. A., Jr.** Use of well logs in the Permian Basin, *in* Oil and gas fields in West Texas—Symposium: West Texas Geol. Soc. Pub. 66–52, p. 12–14, 1966.

In addition to determining the stratigraphic sequence, well logs are used to calculate various petro-physical parameters, porosity and water saturation being the commonest. Some of the methods used to derive other parameters are given in an appendix. High resistivity and low porosity in formations in the Permian basin, as well as rapid vertical change, require more sophisticated interpretation methods.—E.S.L.

Patton, William W., Jr. *See* Miller, Thomas P. 8359

Paulding, B. W., Jr. *See* Brace, W. F. 8496

8659 **Pavoni, N.** Investigations on the recent horizontal crustal movements in the circum-Pacific orogenic belt [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Symposium, no. 10, p. 16, 1966.

8700 **Peck, John H.; Pierce, Kenneth L.** Geologic map of part of the Manchester Islands quadrangle, Lewis County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-581, scale 1:24,000, section, text, 1966.

Mineral resources in the Manchester Islands quadrangle include: a large supply of fine to coarse sand, some argillaceous limestone, and clay from the Crab Orchard Formation. The Ohio Shale is a potential source of oil. Debris slides shown on the map are subject to slow creep and local rapid sliding and flow downslope at times of heavy precipitation and spring thaw, thus posing serious problems to construction, including present roads and railroads.—M.C.M.

8782 **Peck, Raymond E.; Morales, Gustavo A.** The Devonian and Lower Mississippian charophytes of North America: Micropaleontology, v. 12, no. 3, p. 303-324, illus., 1966.

All known charophytes from the Devonian and Lower Mississippian sediments of North America are described, illustrated, and referred to eight species distributed among five genera. Representatives of *Chovanella, Sycidium, Karpinskya, Moellerina* are widely distributed in North America, Europe and Asia; *Eochara* is at present known only from western Canada. A neotype for *Moellerina greenei* Ulrich is selected, and the genus *Trochiliscus* Karpinsky is suppressed as a junior synonym of *Moellerina*.—*from* Authors' abstract

Penzien, J. *See* Jenschke, V. A. 8862

8515 **Petruk, W.** Preliminary mineralogical study of the silver deposits in the Cobalt area, Ontario [with French abs.]: Canada Dept. Mines and Tech. Surveys Mines Br. Inf. Circ. 179, 36 p., illus., tables, 1966.

The silver deposits in the Cobalt area in Ontario consist of mineralized carbonate veins in the Cobalt series sediments, Keewatin rocks, Nipissing diabase, and lamprophyre. The central portions of the mineralized veins consist largely of cobalt-nickel arsenides and native silver in carbonate, and the terminal portions consist of arsenopyrite and sulfides in carbonate. The minerals in these veins occur in a variety of ways, but most of the cobalt-nickel arsenides occur as rosettes and masses. The rosettes in silver-bearing veins contain cores of native silver, and the masses contain irregular aggregates, disseminations, and veinlets of native silver but are richer in native bismuth.—Author's abstract

8777 **Pettyjohn, Wayne A.; Randich, P. G.** Geohydrologic use of lithofacies maps in glaciated areas: Water Resources Research, v. 2, no. 4, p. 679-689, illus., 1966.

In subsurface exploration, it is advantageous to use a series of lithofacies maps as a sequence of overlays plotted on transparent paper. Such maps permit direct visual determination of lithology and areal extent of aquifers; indicate possible stream losses or gains, and boundaries of confining layers; and delineate water-table and artesian zones. They are especially useful in determining buried channels in glaciated areas. The porosity of rock units of an aquifer may be plotted on a lithofacies map and by its volume an estimate made of water in storage. If the water-bearing properties are known, the quantity of water moving through an aquifer and amounts available to wells may be determined. Lithofacies maps also aid in explanation of complex changes in water quality.—G.D.C.

8672 **Philbin, P. W.; Smith, C. W.** Aeromagnetic map of the East Killingly quadrangle and part of the Oneco quadrangle, Connecticut and Rhode Island: U.S. Geol. Survey Geophys. Inv. Map GP-591, scale 1:24,000, 1966.

8673 **Philbin, P. W.; Smith, C. W.** Aeromagnetic map of the Collinsville quadrangle, Litchfield and Hartford Counties, Connecticut: U.S. Geol. Survey Geophys. Inv. Map GP-588, scale 1:24,000, 1966.

8674 **Philbin, P. W.; Smith, C. W.** Aeromagnetic map of the Danielson quadrangle and part of the Plainfield quadrangle, Windham County, Connecticut: U.S. Geol. Survey Geophys. Inv. Map GP-592, scale 1:24,000, 1966.

8738 **Philpotts, John A.; Schnetzler, C. C.; Thomas, H. H.** Rare earth abundances in an anorthosite and a mangerite: Nature, v. 212, no. 5064, p. 805-806, illus., table, 1966.

An anorthosite from Tchitogama Lake, Quebec, has a pattern of normalized rare earth values of the type expected from a liquid derived from material with a noninflexional pattern by extreme fractional crystallization of a solid for which the partition coefficients differ regularly by a constant amount throughout the rare earth group. It is probably a cumulate. The pattern of a mangerite from Grenville Township, Quebec, is typical of most sedimentary rocks, but it is clearly igneous. A direct genetic relation between the two rocks is unlikely, but assimilation could account for the differences if they are cogenetic.—D.B.V.

8427 **Pierce, Jack W.; Good, Donald I.** FORTRAN II program for standard-size analysis of unconsolidated sediments using an IBM 1620 computer: Kansas Geol. Survey Spec. Distrib. Pub. 28, 19 p., illus., tables, 1966.

This program computes the mean, standard deviation, skewness, and kurtosis by the method of moments for size distribution of particles as determined by standard sediment analysis. Both sieve and pipette analyses were performed. The method of moments has been little used because of computational time involved, and is limited in that only a very minor portion of the material can be outside the range of the analytical technique employed. Part of the output is the fraction of the total sample in each size class, and allows the user to plot a cumulative distribution curve or a histogram. Sixteen major steps in the size analysis program are listed. Nomenclature used is tabulated, and a flow sheet and listing of the program are included. Sample problems are described.—E.S.L.

Pierce, Kenneth L. *See* Peck, John H. 8700

8704 **Pierce, Kenneth L.** Bedrock and surficial geology of the McConnellsburg quadrangle, Pennsylvania: Pennsylvania Geol. Survey, 4th ser., Atlas 109a, 111 p., illus., tables, geol. maps, 1966.

In this Valley and Ridge area of southern Pennsylvania, outcropping Cambrian to Devonian formations are divided into five litho-genetic groups: Cambrian and Ordovician carbonate rocks, Ordovician flysch, sandstones of the Taconic clastic wedge, Silurian shales and sandstones, and Upper Devonian silty shales and sandstones of the Acadian clastic wedge. Concentric folds and five high-angle thrust faults of great displacement have en echelon features. The Tuscarora fault, defined by a 10-ft thick mylonite zone at the base of the Reedsville Formation, may have moved several miles; a K-Ar age of 340 m.y. on mylonite indicates Acadian deformation. Abnormally high fluid pressures may have been exerted by the overlying 17,000 feet of sedimentary deposition. The regolith includes roundstone diamictons nearly as old as Cretaceous.—G.D.C.

Pilant, W. L. *See* Knopoff, L. 8828

8445 **Pillay, K. K. Sivasankara.** Characteristic X-rays from (n,γ) products and their utilization in activation analysis [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 711B-712B, 1966.

8797 **Piper, Arthur M.** Potential effects of Project Chariot on local water supplies, northwestern Alaska: U.S. Geol. Survey Prof. Paper 539, 45 p., illus., tables, 1966.

An order-of-magnitude appraisal is developed for concentrations of radioactive nuclides that might be introduced into local water supplies by Project Chariot. This test, originally planned as a nuclear-excavation test in northwestern Alaska, near Cape Thompson, has been postponed indefinitely, but results of this study could be applicable to preliminary evaluations of other proposed nuclear excavations. Cases are cited involving detonation at four different times of year.

Activity in streams due to suspended fallout particles will vary depending upon the amount of runoff (snowmelt or rain). Activity not reaching streams soon after detonation would remain in the area and probably move to streams over a period of years; for most areas, water management problems should vanish within a few years.—V.S.N.

8774 **Pipiringos, George N.** Origin of elements associated with uranium in the Cave Hills area, Harding County, South Dakota: U.S. Geol. Survey Prof. Paper 476-B, p. B1-B75, illus., tables, 1966.

Eight stratigraphic units of the Paleocene Fort Union Formation were chosen for study of the distribution of uranium and 32 other trace elements and for study of the radioactivity equilibrium relations. The highest uranium concentrations and the greatest amount of radioactivity disequilibrium occur near aquifers. These field relations suggest that the initial deposition of the uranium as well as the subsequent leaching and redeposition was accomplished by circulating ground water. The syngenetic and epigenetic origin and subsequent history of the trace elements other than the uranium were studied by three semi-independent methods, based on the assumption that the elements were emplaced in the host rocks in the following ways: (1) as plant constituents, (2) as constituents of the original inorganic fraction of the rock, and (3) as constituents added to the rock by ground water.—*from* Author's abstract

8764 **Poag, C. W.** *Arcanispira depressa* n. sp. from the Florida Miocene Chipola Formation: Cushman Found. Foram. Research Contr., v. 17, pt. 4, p. 140-141, illus., 1966.

[The rotaliid foraminifer] *Arcanispira depressa* n. sp., from the type locality of the Miocene Chipola Formation of northwestern Florida, is described and illustrated, and its possible stratigraphic value is suggested. A direct evolutionary linkage is proposed between *A. depressa* n. sp. and *A. bacata* Poag of the eastern Mississippi Paynes Hammock Formation.—Author's abstract

8710 **Poquet, Jean.** Réflexions géomorphologiques relatives au Québec méridional: Cahiers Géographie Québec, v. 10, no. 19, p. 107-113, 1966.

Quaternary glaciation acquires its greatest geomorphologic significance in Quebec because of the tectonic consequences. Glacial features are extremely rare, and secondary to fluvial erosion forms. Rivers follow fractures, faults, and folds, and valleys are flanked by terraces converging downstream. The smooth character of the Quebec landscape is determined by multiple erosion surfaces, with relief due to the rejuvenation of rivers by isostatic uplift. Poquet concludes that uplift in Quebec is just starting and has not yet reached the stage of greatest acceleration.—E.S.L.

8876 **Post, Austin.** The recent surge of Walsh Glacier, Yukon and Alaska [with French and German abs.]: Jour. Glaciology, v. 6, no. 45, p. 373-381, illus., table, 1966.

After a 40-year period of stagnation, Walsh Glacier which lies across the Alaska-Yukon boundary made a rapid surge between 1961 and 1965, amounting to 10.1 km in the central part. Paige's (1965) suggestion that this surge was caused by the Alaskan earthquake of March 27, 1964, is incorrect since photographs show that the movement began in the upper portion of the glacier in late 1960 or 1961. The 1965 photographs indicate that the surge is about completed; a previous surge probably occurred between the time of the International Boundary Commission mapping in 1912 and about 1918.—V.S.N.

Potter, Paul Edwin. *See* Carr, Donald C. 8803

8412 **Power, Wilson H.; Fabuss, Bela M.; Satterfield, Charles N.** Transient solute concentrations and phase changes of calcium sulfate in aqueous sodium chloride: Jour. Chem. and Eng. Data, v. 11, no. 2, p. 149-154, illus., tables, 1966.

Change in solute concentration with time of 0.25*m* or 1.0*m* NaCl in contact with gypsum, β-hemihydrate, β-soluble anhydrite, or insoluble anhydrite was determined

over a temperature range of 25° to 105°C; accompanying changes in the solid phase were also determined. Under thermodynamically favorable conditions β hemihydrate and β-soluble anhydrite rapidly hydrate to form gypsum. Dehydration rate of gypsum at 95° and 105°C to form insoluble anhydrite is faster in 1.0*m* NaCl than in pure water. Some changes in solubility and solid phase composition occur only after an induction period of two days or more. Solubility product constants for gypsum and insoluble anhydrite agree closely with previously published values. From present data and earlier literature values, a correlation is presented for estimating solubility of gypsum and anhydrite over a wide ionic-strength range.—*from* Authors' abstract

8878 **Puig, H.** Le paysage de la Barranca de Meztitlan [also English and Spanish texts]: Photo Interprétation, no. 66-2, p. 22-28, illus., 1966.

A stereoscopic set of airphotos from Hidalgo, Mexico, with an interpretive overlay and brief text comprise the paper. Three main regions are revealed: two plateaus of eruptive rock, a marl area where erosion is heavy and the dendritic drainage pattern stands out, and a calcareous area with sharp relief structures revealing the folding direction.—E.S.L.

8848 **Purtymun, William D.; Johnson, George L.; John, Edward C.** Distribution of radioactivity in the alluvium of a disposal area at Los Alamos, New Mexico, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D250-D252, illus., table, 1966.

Fine particles in alluvial material in a disposal area for liquid radioactive wastes at Los Alamos have greater affinity for radionuclides than coarse particles; however, most of the radioactivity is in the coarse material, which is more abundant. The radioactivity in the alluvium is dispersed by waste water and storm runoff and decreases with distance from the point of effluent outfall. Most of the radionuclides are retained in the upper three feet of the deposits, resulting in very little change in the quality of the ground water perched in the alluvium.—Authors' abstract

Putnam, D. F. *See* Chapman, L. J. 8883

8394 **Rand, M. H.** Rock mechanics and the mining industry: Canadian Mining and Metall. Bull., v. 59, no. 654, p. 1177-1183, 1966.

The field of rock mechanics involves measurements of ground stability, pre-stress, variations of stress, and stress magnitudes. Methods of measurement are described.—A.R.K.

Randich, P. G. *See* Pettyjohn, Wayne A. 8777

Rascón, O. A. *See* Herrera, Ismael. 8857

Ratcliffe, Nicholas M. *See* Zen, E-an. 8343

Rathbun, Ronald E. *See* Flaxman, Elliott M. 8697

Raudkivi, A. J. *See* Flaxman, Elliott M. 8697

Raup, Robert B. *See* Simons, Frank S. 8853

8867 **Ravara, Artur.** Spectral analysis of seismic actions, *in* World Conf. Earthquake Eng., 3d, New Zealand, 1965, Proc., V. 1: Wellington, New Zealand Inst. Engineers, p. III-195—III-204, illus., tables, 1965 [1966].

Some accelerograms of strong-motion earthquakes recorded in the U.S.A. in the late decades are analysed. The power content of these earthquakes is characterized by their acceleration spectral density determined in a digital computer. The results are compared with values already available in the literature.—Author's abstract

8517 **Ray, Teri.** Bibliography of New Mexico geology and mineral technology, 1961-1965: New Mexico Bur. Mines and Mineral Resources Bull. 90, 124 p., 1966.

The volume includes a list of abbreviations and sources, the bibliography (serial publications), a list of books, a list of graduate papers, and a subject index.—M.C.M.

Raymond, W. H. *See* Segerstrom, Kenneth. 8837

8717 **Reckendorf, Frank F.; Parsons, Roger B.** Soil development over a hearth in Willamette Valley, Oregon: Northwest Sci., v. 40, no. 2, p. 46–55, illus., table, 1966.

The hearth site is exposed in the cutbank of the Luckiamute River, about one mile upstream from its junction with the Little Luckiamute. The site occurs within the lowest terrace, and charcoal from it is dated at 5,250±270 yr B.P. The soil profile is described, including six horizons in the 109 cm above the hearth, the horizon including the hearth, and one below it. Particle size and chemical distribution data are tabulated by horizon. A significant degree of soil development is expressed in the 5,250±270 yr period. The date also provides a maximum time for accumulation of 109 cm of alluvium along the river.—E.S.L.

8548 **Rees, Anthony I.** The effect of depositional slopes on the anisotropy of magnetic susceptibility of laboratory deposited sands: Jour. Geology, v. 74, no. 6, p. 856–867, illus., table, 1966.

Sand of medium grain-size containing about 0.1 percent magnetite was deposited in quiet water on bottom surfaces of various slopes, ranging from 0° to 35°. Measurements of cored cylinders by the torque method showed magnetic susceptibility minima roughly perpendicular to the depositional surface and, in the case of the steeper slopes, maxima near the azimuth of the dip, thus similar to anisotropy noted in sediments deposited on a horizontal bed in running water.—R.E.W.

8835 **Rehwald, Gerhard.** The application of ore-microscopy in beneficiation of ores of the precious metals and of the nonferrous metals, *in* Applied ore microscopy—Theory and technique (1st English edition): New York, Macmillan Co., p. 439–537, illus., tables, 1966.

The application of microscopic methods of investigation is of prime importance for efficient control and further improvement in beneficiation. The section on mineral determination gives a list of 12 observational facts of importance to the engineer, and discusses each in detail, illustrated by polished sections. A second section is devoted to the textures of ore minerals. A general classification, revised according to ore dressing requirements, is given, and the properties of mineral grains and mineral aggregates discussed and illustrated. Genetic textures are divided into primary, alteration, and deformation textures. The occurrence of individual metals comprises the third section. The mineralogy and ore dressing methods of 15 metals are given.—E.S.L.

8404 **Reyes, Salvador Faustino.** Elastic-plastic analysis of underground openings by the finite element method [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 814B, 1966.

Richards, M. *See* Vacquier, V. 8568

Ridge, Kathleen F. *See* Carr, Donald C. 8803

8455 **Riecken, Charles Christopher.** Petrology of the Striped Rock Granite and surrounding rocks, Grayson County, Virginia [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 859B–860B, 1966.

8575 **Rinehart, J. S.** Geyser action in Yellowstone National Park [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Div. Mtg. Solid Earth Physics II, p. 36, 1966.

Rinehart, W. A. *See* Dehlinger, P. 8554

Ristedt, H. *See* Eichler, R. 8430

Riva, John. *See* Osborne, F. Fitz. 8776

8836 **Roberson, Charles E.** Solubility implications of apatite in sea water, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550–D, p. D178–D185, illus., tables, 1966.

Solubility studies using fluorapatite and marine phosphorite in artificial sea-water solutions confirm that the solubility of these solid phases is a function of pH. The data suggest that at pH 8.2, the equilibrium value for total dissolved phosphate is about 0.2 micromoles per liter. From this it is inferred that the bulk of ocean water is near saturation with respect to fluorapatite. Therefore, deposition of phosphorite whose main component is fluorapatite can be explained on continental-shelf areas where a decrease in solubility occurs because of loss of CO_2. A value determined for the second dissociation of phosphoric acid suggests that the main phosphate species is HPO_4^{-2} and that at pH 8.1 its concentration is 100 times greater than $H_2PO_4^{-1}$.—*from* Author's abstract

Roberts, J. W. *See* Parker, J. William. 8382

8685 **Robertson, Eugene C.** The interior of the Earth—An elementary description: U.S. Geol. Survey Circ. 532, 10 p., illus., 1966.

Evidence on structure and composition of the Earth's interior comes from: observations of surface rocks; geophysical data from earthquakes, flow of heat from the interior, the magnetic field, and gravity; laboratory experiments on surface rocks and minerals; and comparison of the Earth with other planets, the Sun, stars, and meteorites. Major structural components in the Earth that are separated by sharp discontinuities are crust, mantle, and core. The crust forms a very thin surface skin, the mantle is a thick shell that extends half the radius down into the Earth, and the core occupies the central part. The crust and upper mantle are known to vary in physical and chemical characteristics, both horizontally and vertically; the lower mantle and core are generally assumed to be uniform because their diagnostic geophysical phenomena are masked by the physical properties of the upper layers.—*from* Author's abstract

8752 **Rohrer, Willis L.** Geology of the Adam Weiss Peak qudrangle, Hot Springs and Park Counties, Wyoming: U.S. Geol. Survey Bull. 1241–A, p. A1–A39, illus., table, geol. map, 1966.

Exposed formations of the Adam Weiss Peak quadrangle range in age from Late Cretaceous to Recent; unexposed formations penetrated by drilling include rocks as old as Mississippian in age. Thin alluvial deposits of late Pleistocene to Recent age are present; Pleistocene alluvium was dated by radiocarbon methods [wood = 34,700 ± 2,200 yr B.P.]. Geologic structures in the area are broad anticlines and synclines, normal faults, and the Enos Creek detachment fault. Structural deformation related to the Laramide orogenic episode resulted in large folds of late Paleocene age. Some of these folds are favorable for the accumulation of oil and gas.—*from* Author's abstract

Roller, J. C. *See* Gibbs, J. F. 8354

8691 **Romer, Alfred Sherwood.** Vertebrate paleontology (3d edition): Chicago, Ill., Univ. Chicago Press, 468 p., illus., tables, revised 1966; originally published 1933.

This volume represents a thorough revision of the 2d edition (1945), particularly the sections relating to fishes, amphibians, older reptile assemblages, and more primitive mammal types. About half the text has been rewritten, 66 new illustrations added, and 80 others replaced. After an introductory chapter, 26 chapters are arranged as a group-by-group treatment, tracing out the ramifications of the family tree. Major structural features of each group are described at some length. Three chapters are devoted to vertebrate history. A section on classification includes a comprehensive list of genera, with a brief record of the ages and areas of occurrence. A bibliography is included, with special emphasis on comprehensive monographs,

bibliographies, and well-illustrated descriptions of typical forms. Some notes regarding workers in the field are included.—E.S.L.

Rooney, Rosalia. *See* Carr, Donald C. 8803

Rosenblueth, Emilio. *See* Herrera, Ismael. 8856

Rosenblueth, Emilio. *See* Herrera, Ismael. 8857

8861 **Rosenblueth, Emilio.** Theme IV—Earthquake resistant design, construction, and regulations, *in* World Conf. Earthquake Eng., 3d, New Zealand, 1965, Proc., V. 3: Wellington, New Zealand Inst. Engineers, p. IV-1—IV-22, 1965 [1966].

Data presented in this session of the conference are summarized very briefly. Of the 37 papers reviewed one deals with earthquake insurance, one with foundations (bridge piles and piers), one with elevated tanks, two with bridges, three with special structures, five with dams, and the remaining 24 with buildings and building code provisions. One paper, by J. A. Blume, is cited separately.—V.S.N.

Ross, Donald C. *See* Stewart, John H. 8341

8890 **Rubin, Jacob.** Theory of rainfall uptake by soils initially drier than their field capacity and its applications: Water Resources Research, v. 2, no. 4, p. 739-749, illus., 1966.

The Darcian approach to moisture transfer in unsaturated soils yields a flow equation used to formulate a rainfall infiltration theory that may be useful in solving a variety of hydrologic engineering problems. However, a careful check must be made of its limitations. It cannot be used when soil exhibits significant air compression, parameter hysteresis, fabric transformations, or areal heterogeneity. For soils with known moisture parameters and rains of given intensity-pattern the theory, whenever applicable, can furnish useful information in dealing with problems of runoff control or sprinkler irrigation.—G.D.C.

8683 **Rucklidge, John.** Observation of hollows in the snow surface of Torv Gletscher, East Greenland [with French and German abs.]: Jour. Glaciology, v. 6, no. 45, p. 446-449, illus., 1966.

Many elongated hollows about 300 m long, 200 m wide and 30 m deep occur on the surface of Torv Gletscher in a region where the flow of the glacier splits in several directions. Their possible origin in crevasse-type opening rather than by slumping or surface deformation is favored by the exposure of stratified layers in the steepest slopes. It is proposed that the central region of the glacier where the hollows occur moves very slowly in relation to the ice on the sides, where the flow is channeled into distributary glaciers. Crevasses in the center become filled with snow, but the depression on the surface will in time show microclimatological effects.—G.D.C.

8773 **Rudman, Reuben.** Low-temperature X-ray diffraction powder techniques: Norelco Reporter, v. 13, no. 2, p. 61-62, illus., 1966.

Most of the emphasis in low-temperature X-ray diffraction techniques has been on the growth and study of single crystals; the advantages of powder techniques have been overlooked. Low-temperature powder techniques are reviewed and a relatively simple apparatus, found to be useful for routine studies, is described. If the crystallites in a powder sample are randomly oriented, the diffraction pattern obtained is independent of sample alinement, so can be quickly obtained for a survey of possibly isostructural compounds, to determine major phase transitions, and to determine coefficients of thermal expansion. The equipment can be used not only on an unmodified 57.3 mm radius Philips powder camera, but with a diffractometer with modified sample holder.—G.D.C.

8893 **Runnels, L. K.** Ice: Sci. American, v. 215, no. 6, p. 118-126, illus., 1966.

This is a semipopular article concerned primarily with the orientation of H_2O molecules in ice crystals. To a first approximation the orientation is random. Migrating lattice faults may account for the polarization of ice as well as its property of semiconductivity.—D.W.R.

Russell, R. D. *See* Jensen, Oliver. 8417

8521 **Safford, J. M.; Lander, W. T.** Manuscript [circa 1895] of the faults of the Wells Creek Basin, *in* Circumferential faulting around Wells Creek Basin, Houston and Stewart Counties, Tennessee, by C. W. Wilson, Jr., and R. G. Stearns: Tennessee Acad. Sci. Jour., v. 41, no. 1, p. 38–46, illus., 1966; reprinted in Tennessee Div. Geology Inf. Circ. 15, 1966.

Of the ten Paleozoic formations listed for this area, it is the upper five on the outside in which the greater faults are found, all of early Carboniferous age except for the Baker black shale [Chattanooga]. Exposures of the Baker shale, found first in a circle on the rim, and then others, aided in working out a pattern of three concentric faults, evidences for which are described from place to place. An east–west dividing line, where exposures are not clear, is considered an axis of oscillation. Other faults lie almost altogether outside the circles.—G.D.C.

8880 **Saint-Onge, D.; Aitkens, D. S. W.** Morphologie glaciaire dans le Canada septentrional [also English and Spanish texts]: Photo Interprétation, no. 66-1, p. 1–7, illus., 1966.

A stereoscopic set of airphotos, scale 1:60,000, in the Hanbury area, Northwest Territories, is presented with an overlay to show raised beaches, drumlins, a meltwater channel, an esker complex, muskeg, and tundra polygons. A brief text interprets the features.—E.S.L.

8795 **Saito, Tsunemasa; Burckle, Lloyd H.; Ewing, Maurice.** Lithology and paleontology of the reflective layer horizon A: Science, v. 154, no. 3753, p. 1173–1176, illus., table, 1966.

Cores recovered from horizon A [in the North Atlantic basin] are Late Cretaceous (Maestrichtian) in age and consist of alternating layers of calcareous turbidites and "red clay." The presence of red clay suggests that the water depth in this area during Cretaceous time was at least as great as at present—more than 5,100 m. A middle Cretaceous (Cenomanian) core consisting of interbedded sand and gravel and light-to-dark-gray lutite was taken in the same area from a layer stratigraphically below the horizon; the presence of hydrogen sulfide and iron sulfide may indicate anaerobic conditions that may be attributable to local ponding of sediment in Cenomanian time.—Authors' abstract

8426 **Sampson, Robert J.; Davis, John C.** FORTRAN II trend-surface program with unrestricted input for the IBM 1620 computer: Kansas Geol. Survey Spec. Distrib. Pub. 26, 12 p., 1966.

Three-dimensional geologic data are often conveniently summarized and interpreted by reduction to a simple geometric shape. A surface can be fitted to the data by an extension of the least-squares, curve-fitting procedure used in curvilinear correlation and regression analysis. The fitted surface is an approximation or "trend" of the data, whereas deviations from the surface indicate local irregularities. The program described will produce trend-surface and residual values of the general first-, second-, third-, and fourth-degree equations. The equations used to generate the surfaces, correlation coefficients, and related values for each order are also printed.—*from* Authors' introduction

Sampson, Robert J. *See* Davis, John C. 8679

8746 **Saskatchewan Dept. Mineral Resources.** Saskatchewan's metallic and industrial minerals: Regina, Saskatchewan Dept. Mineral Resources, 94 p., illus., 1966.

The booklet was designed as an introduction to the minerals of Saskatchewan, methods employed in assessing their value, removal from their surroundings, and

their processing to a state of economic worth. The chapters cover: the geology of the northern Precambrian area and southern area, including glacial geology; exploration and development; recovery and treatment of metallic minerals; and industrial minerals which are coal, clays, sodium sulfate, potash, salt, sand and gravel, silica sand, bentonite, pumicite, and marl.—E.S.L.

Satterfield, Charles N. *See* Power, Wilson H. 8412

8513 **Savit, Carl H.** A proposed standard format for nine-track digital tape: Geophysics, v. 31, no. 4, p. 812–815, illus., 1966.

A compact standard format is proposed for nine-track, half-inch digital seismic tapes.—D.B.V.

Sawyer, Jerry R. *See* White, B. Ross. 8481

8687 **Scheidegger, A. E.; Langbein, W. B.** Probability concepts in geomorphology: U.S. Geol. Survey Prof. Paper 500-C, p. C1–C14, illus., 1966.

Rivers and landforms that are produced by the action of flowing water may be dominated by random processes. The complexity of the phenomena seems to be beyond complete resolution of the forces and resistances involved. An assumption of randomness appears to offer a direct approach to a study of landforms and of the hydraulic geometry of rivers.—Authors' abstract

8711 **Scheidegger, A. E.; Langbein, W. B.** Steady state in the stochastic theory of longitudinal river profile development [with French abs.]: Internat. Assoc. Sci. Hydrology Bull., v. 11, no. 3, p. 43–49, 1966.

An assumption is made that a river profile represents a steady state analogous to a condition of minimum entropy production in irreversible thermodynamics. In this analogy temperature represents elevation, and heat flow represents mass flow. Including necessary relation between rate of mass transport and slope, the assumption leads to profiles that are concave to the sky, as found in nature. The actual profile depends on the transport-slope relation.—Authors' abstract

8745 **Scheidegger, A. E.** Effect of map scale on stream orders [with French abs.]: Internat. Assoc. Sci. Hydrology Bull., v. 11, no. 3, p. 56–61, illus., 1966.

In any scheme of stream ordering, the order assigned to a given stream segment depends on the scale of the map used to make the drainage basin analysis, since new forkings at the headwaters may become observable as the map scale is increased. If one new set of forkings becomes observable, the Strahler orders increase by one; the consistent ("logarithmic") scheme of orders recently proposed by Scheidegger changes values in varying amounts depending on the topology of the newly observable streams.—Author's abstract

8891 **Scheidegger, Adrian E.** Statistical description of river networks: Water Resources Research, v. 2, no. 4, p. 785–790, illus., 1966.

A scheme for the statistical description of the geometry of a river network can be devised by focusing attention on the statistics of junctions. The statistics of a river network can also be regarded as the outcome of a stochastic branching process. The connection between the two possible statistical descriptions of river networks is given and, as an example, the case of a river network that has a constant bifurcation ratio ('Horton net') is discussed.—Author's abstract

8347 **Schell, Elmer M.; Yochelson, Ellis L.** Permian–Triassic boundary in eastern Uintah County, Utah, and western Moffat County, Colorado, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D64–D68, illus., 1966.

The Permian Park City Formation exposed along the south flank of the Uinta Mountains near the Utah–Colorado State line is redefined to include 25 to 67 feet of tawny beds at the top. Previously, these beds were included in the overlying Triassic Moenkopi Formation. The tawny beds consist mainly of silty limestone

and dolomite but contain a cherty zone and a phosphatic dolomite marker bed near the top. A limestone containing a Permian fauna underlies the marker bed. The tawny beds are correlated with the upper unit of the Franson Member of the Park City Formation in the Ashley Creek–Brush Creek area, north of Vernal, Utah.—Authors' abstract

8739 **Schmertmann, John H.** Stability of slopes in anisotropic soils—Discussion [of paper 4405 by K. Y. Lo, 1965]: Am. Soc. Civil Engineers Proc., v. 92, paper 4594, Jour. Soil Mechanics and Found. Div., no. SM 1, p. 203–207, illus., 1966.

The writer discusses three points that should be considered when evaluating the significance of the graphs presented in Lo's paper: inherent anisotropy versus effective stress, correction when using vane test strengths (still large), and possibility of undrained strength anisotropy with shear stress direction.—E.S.L.

Schnetzler, C. C. *See* Philpotts, John A. 8738

Scholz, C. *See* Brace, W. F. 8496

8433 **Schwarz, E. J.** Magnetization of Precambrian sulphide deposits and wall rocks from the Noranda district, Canada: Geophysics, v. 31, no. 4, p. 797–802, illus., 1966.

The magnetic properties of 43 oriented samples of massive sulfides, sulfide-bearing rocks, quartz porphyries, and diabases from the Quemont and Horne mines in northwest Quebec have been determined. The low-field susceptibility, average intensity of net remanence, and ratio of remanent to induced magnetization are all higher for the massive sulfides than for the wall rocks, and the directions of natural remanence of nearly all samples of sulfide and wall rock are closely parallel to the geomagnetic field. Thus the bodies studied tend to produce positive magnetic anomalies at the surface. Stability tests indicate a very large unstable component of the remanence.—D.B.V.

8491 **Scolaro, Reginald J.** Some Florida upper Miocene Bryozoa—Paleoecology and taxonomy [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2327, 1966.

8874 **Scott, Cloyd H.; Stephens, Howard D.** Special sediment investigations—Mississippi River at St. Louis, Missouri, 1961–63: U.S. Geol. Survey Water-Supply Paper 1819-J, p. J1–J35, illus., tables, 1966.

Four sets of comprehensive hydraulic and sediment data for deep flows of the Mississippi River at St. Louis are presented with explanations of field and computational procedures. These data cover a range of mean velocity from 3.3 to 5.6 feet per second, mean depth from 22 to 37 feet, and suspended-sediment concentration from 314 to 928 ppm, of which 9–46 percent was sand, 30–46 percent silt, and 20–26 percent clay. Turbulence constants computed from streamflow-measurement notes or from vertical-velocity profiles averaged 0.34 and 0.35, respectively. Experimentally determined z_1's for various size ranges plotted against corresponding fall velocities indicate that the average power of the fall velocity is about 0.7.—W.L.G.

Scott, James H. *See* Carroll, Roderick D. 8356

8860 **Scott, Ronald F.** Soil mechanics and foundation engineering aspects of the Alaskan earthquake of March 27, 1964, *in* World Conf. Earthquake Eng., 3d, New Zealand, 1965, Proc., V. 1: Wellington, New Zealand Inst. Engineers, p. I-157–I-172, illus., 1965 [1966].

This report begins by briefly summarizing the geology and soil profiles of the Anchorage area. The most important effects of the earthquake with respect to soil engineering are then qualitatively described and illustrated and a brief discussion of the stability of slopes in the region of interest is presented.—Author's summary

Screwvala, F. N. *See* Fleming, J. F. 8855

8476 **Scull, B. J.; Felix, C. J.; McCaleb, S. B.; Shaw, W. G.** Inter-discipline approach to paleoenvironmental interpretations [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2320–2321, 1966.

Seed, H. Bolton. *See* Duncan, J. M. 8760

8772 **Seed, H. Bolton.** A method for earthquake resistant design of earth dams: Am. Soc. Civil Engineers Proc., v. 92, paper 4616, Jour. Soil Mechanics and Found. Div., no. SM 1, p. 13–41, illus., 1966.

The method presented incorporates a consideration of the time history of forces developed in the embankment during the earthquake, and measurements of soil behavior under simulated earthquake loading conditions. Field experience, analyses, and laboratory investigations all indicate that such innovations are desirable in design procedure. The method also follows Newmark's concept of earthquake design in which stability is assessed in terms of embankment deformations rather than as a factor of safety developed at some instant during an earthquake. The method is primarily applicable for analyzing stability of embankments constructed of saturated soil which is sufficiently impervious so that no drainage will occur during the period of ground shaking. As improved methods for predicting embankment deformation are developed, they can readily be incorporated in the design procedure.—*from* Author's abstract

8821 **Segal, Ronald H.** Taxonomic study of the fossil species of the genus *Cryptantha* (Boraginaceae): Southwestern Naturalist, v. 11, no. 2, p. 205–210, illus., 1966.

Distinguishing features of the nutlets (fruits) of the fossil species of *Cryptantha* from the Pliocene Ogallala Formation of western Kansas are discussed. *C. coroniformis*, *C. auriculata*, and *C. chaneyi* are compared to living species where possible, and distributional ranges of the fossil species are given.—V.M.J.

8822 **Segal, Ronald H.** A review of some Tertiary endocarps of *Celtis* (Ulmaceae): Southwestern Naturalist, v. 11, no. 2, p. 211–216, illus., table, 1966.

Taxonomy of the fossil species of *Celtis* is reviewed and morphologic features of the endocarp (fruit stone) are described. Well preserved fossil endocarps are abundant in Tertiary deposits in the High Plains region of central United States. *C. hatcheri* (Oligocene, near Scenic, N. Dak.) and *C. willistoni* (Pliocene, Ogallala Formation, Kansas, and Miocene–Pliocene, widespread) are shown to be distinct species. Comparisons are made with the living hackberry, *C. reticulata*, which is common in the same region.—V.M.J.

8837 **Segerstrom, Kenneth; Raymond, W. H.** Preliminary results of geochemical prospecting in northern Michigan, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D186–D189, illus., table, 1966.

High concentration of copper, lead, and zinc were found locally in soils of Marquette County, Mich. Samples with anomalous metal concentrations were collected where the cover of surficial materials (chiefly ground moraine) is thin and contains abundant admixtures of colluvium derived from bedrock ridges. Marked bunching of anomalies showed up in three small areas north of the Dead River Storage Basin. Soils underlain by a thick cover of glacial materials (chiefly ice-contact deposits and outwash sand) did not show anomalous concentrations of the base metals. It is concluded that most base metals in these concentrations are not from distant sources, and that their migration has been largely postglacial.—Authors' abstract

8682 **Seligman, G.** Walter Herman Bucher, 1888–1965: Jour. Glaciology, v. 6, no. 45, p. 460–461, portrait, 1966.

8477 **SEPM, Gulf Coast Section.** (Study Group). Interpretation of depositional environment in Gulf Coast petroleum exploration from paleoecology and related stratigraphy [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2321, 1966.

8493 **SEPM, Gulf Coast Section.** (Committee on Paleoecology). Foraminiferal ecologic zones of Gulf Coast [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2327, 1966.

8401 **Service, A. L.** An evaluation of the Western phosphate industry and its resources—[Pt.] 3, Idaho: U.S. Bur. Mines Rept. Inv. 6801, 201 p., illus., tables, 1966.

Idaho has nearly 6 billion tons of potential sources of phosphorite, 10 to 31 percent P_2O_5, above and within 100 feet below entry level. This is the largest potential of any State in the United States. In 1963 Idaho ranked third after Florida and Tennessee in total mine and marketable production of phosphate rock; Montana ranked fourth. This report describes phosphate deposits, mines, and prospects in 10 districts covering most of the Idaho phosphate field. All mine production of phosphate rock in Idaho comes from surface mines and is processed to phosphate fertilizers, phosphoric acid, and elemental phosphorus. Producing districts are Fort Hall (Gay mine), Trail Creek (Conda and Ballard mines), and Crow Creek (Georgetown Canyon mine).—H.R.B.

Shaw, W. G. *See* Scull, B. J. 8476

Sheridan, E. T. *See* DeCarlo, J. A. 8735

Sheridan, Robert E. *See* Heezen, Bruce C. 8377

8425 **Sherif, M. A.** Relationship between the total and the effective stress-failure envelopes in saturated cohesive soils: Trend Eng., v. 18, no. 2, p. 4–7, illus., 1966.

On the basis of experiments with saturated kaolinite clay, a relation is shown between the maximum principal failure stress obtained during consolidated undrained tests and the maximum deviator stress obtained from slow tests. On the basis of this relation, Sherif proposes a new method by which the effective stress envelope can be determined from the results of consolidated undrained tests without pore-pressure measurements. The proposed method is applicable to reliable test results conducted by others in earlier years.—E.S.L.

Shimp, N. F. *See* Clayton, R. N. 8448

8724 **Short, Nicholas M.** Shock processes in geology: Jour. Geol. Education, v. 14, no. 4, p. 149–166, illus., table, 1966.

The importance of shock in terrestrial geologic processes lies in its genetic association with meteorite impact and other cryptoexplosion structures. Shock waves are pressure waves that travel at supersonic velocities and, depending on their intensities, are capable of vaporizing, melting, mineralogically transforming, or strongly deforming rock materials. Shock pressures of 100's of kilobars produce unique effects which have been observed in nuclear explosion craters, laboratory shock experiments, meteorites, and meteorite craters. Similar features are also found in many structures for which an impact origin has been proposed. Studies of the nature of shock waves, the mechanics of explosion and impact crater formation, and the features diagnostic of shock action apply directly to astrogeologic investigations of terrestrial and lunar craters and to meteorites.—Author's abstract

8832 **Short, Nicholas M.** Shock-lithification of unconsolidated rock materials: Science, v. 154, no. 3747, p. 382–384, illus., 1966.

Loose quartz grains packed around chemical explosives are forced during cratering explosions into compacted, coherent masses resembling sandstone blocks found at certain meteorite craters. Sandstone-like lumps found at the Wabar (Arabia) meteorite craters are similar to these shock-lithified sands. Shock-lithification by impact may be effected on Moon as large meteorites strike surfaces covered with rubble from earlier collisions.—Author's abstract

Sierra, P. *See* Gershanik, S. 8815

8340 **Simmons, George C.** Stream anticlines in central Kentucky, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D9-D11, illus., 1966.

Small nontectonic folds called stream anticlines occur in interbedded limestone and shale of the Upper Ordovician in central Kentucky. Although their amplitude commonly is only a few feet, some anticlines are more than half a mile long; most are fractured along their crests. Stream anticlines are unrelated to tectonic features, and their coincidence with valley bottoms suggests a Recent origin. This origin is substantiated at one place by an eyewitness account near Stanford, Ky.—Author's abstract

8853 **Simons, Frank S.; Raup, Robert B.; Hayes, Philip T.; Drewes, Harald.** Exotic blocks and coarse breccias in Mesozoic volcanic rocks of southeastern Arizona, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D12-D22, illus., 1966.

In the Canelo Hills and the Huachuca, Patagonia, and Santa Rita Mountains of southeastern Arizona, thick sequences of Mesozoic volcanic and volcanic-sedimentary rocks contain sizable exotic blocks or coarse sedimentary breccias of older rocks. The large blocks were emplaced by dragging or rafting by lava flows, by gravity sliding, or possibly by transport in ash flows. These exotic blocks and coarse breccias, together with conglomerate at several horizons, indicate widespread tectonic activity in southeastern Arizona during Mesozoic time.—Authors' abstract

Sipes, L. D., Jr. *See* Hogan, C. S. 8825

Skibitzke, H. E. *See* Harshbarger, J. W. 8889

8475 **Skinner, Hubert C.** Modern paleoecological techniques—An evaluation of role of paleoecology in Gulf Coast exploration [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2320, 1966.

8489 **Skinner, Hubert C.** Paleoecology of Late Neogene deposits at Belle Glade, Florida [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2326, 1966.

8483 **Sloane, B. J.** Structural history of Houma embayment [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2323-2324, 1966.

8805 **Smedes, H. W.** Geology and igneous petrology of the northern Elkhorn Mountains, Jefferson and Broadwater Counties, Montana: U.S. Geol. Survey Prof. Paper 510, 116 p., illus., tables, geol. map, 1966.

A thick section of upper Paleozoic and Mesozoic sedimentary rocks and Upper Cretaceous volcanic rocks were intruded by basalt and andesite, and large blocks of the volcanic pile foundered in shallow magma reservoirs. The region was folded, faulted, and then invaded by the Boulder batholith, probably during Late Cretaceous and Paleocene time. The batholith was emplaced in at least four main stages: (1) gabbro, syenogabbro, syenodiorite, and related mafic rocks; (2) granodiorite; (3) Butte Quartz Monzonite; and (4) aplite, alaskite, pegmatite, granite, and related felsic rocks. The batholith and older rocks were faulted, cut by metalliferous quartz veins, and eroded, followed by intrusion of quartz latite, formation of chalcedony veins, and intrusion and extrusion of rhyolite.—H.W.S.

Smith, C. W. *See* Philbin, P. W. 8672

Smith, C. W. *See* Philbin, P. W. 8673

Smith, C. W. *See* Philbin, P. W. 8674

8727 **Smith, F. G.** A hybrid man-machine teaching method: Jour. Geol. Education, v. 14, no. 4, p. 123-126, 1966.

Computer programs to select statements for objective examinations, score the responses by the students, and analyze the scoring efficiency of the items, are

described briefly. Their use in teaching elementary general geology appears to be practical and the results of a full-scale test were good.—Author's abstract

Smith, H. W. *See* Moodie, C. D. 8716

Smith, R. A. *See* Bott, M. H. P. 8434

8728 **Southwood, Robert J.** Ground-water levels in Indiana, 1955–1962: Indiana Div. Water Resources Bull. 30, 118 p., illus., tables, 1966.

This report represents a compilation of ground-water levels based on the measurements in 28 key observation wells and 116 other observation wells in Indiana; wells are shown on a map. There was a general downward trend in the southern part of the state, an upward trend in the central part, and a downward trend in the northern area during 1955–62.—M.C.M.

8877 **Spector, Allan.** A gravity survey of the Melville Island icecaps [with French and German abs.]: Jour. Glaciology, v. 6, no. 45, p. 393–400, illus., 1966.

A gravity survey was made in June of 1963 of four icecaps on western Melville Island, Canadian Arctic Archipelago. Ice thicknesses were interpreted from Bouguer anomalies at 138 stations. The regional gravity field of the area has a simple form and is associated with a uniform bedrock geology. Because of this, the interpretation of the gravity data was greatly simplified in comparison with the more usual glaciological problem. It was found that greatest ice thicknesses ranged from 30 to 50 m, filling hidden valleys or depressions under the main icecap body. Icecap volumes ranged from 0.2 to 1.0 km^3.—Author's abstract

8509 **Spelman, Allen R.** Stratigraphy of Lower Ordovician Nittany Dolomite in central Pennsylvania: Pennsylvania Geol. Survey, 4th ser., Bull. G 47 (General Geology Rept.), 187 p., illus., tables, 1966.

The Nittany was measured and described in detail at four sections in the Bellefonte (type) area, Centre County, and three lithologic sequences were distinguished and named as members, on the basis of presence or absence of quartz grains. Changes in the physical and mineralogic character of each member and of adjacent formations, in eight sections southwestward to Lutzville, are discussed, and fossils collected are listed. Attention is given to the influence of various environments on the carbonate sediment, and the paleogeography of the area is considered. The Nittany Dolomite and adjacent formations are correlated with those in nearby areas. Appendix A gives the systematic paleontology, and Appendix B, 12 measured sections. Detailed stratigraphic columns and a cross section of the Nittany accompany the report.—E.S.L.

Spitz, Owen T. *See* O'Leary, Mont. 8678

Stacey, F. D. *See* Dickson, G. O. 8418

Stacey, R. A. *See* Bott, M. H. P. 8434

8701 **Stearns, Harold T.** Road guide to points of geologic interest in the Hawaiian Islands: Palo Alto, Calif., Pacific Books, 66 p., illus., tables, 1966.

Hawaiian volcanoes are built over a 1,600-mi fissure which opened in earliest Tertiary time, and are progressively younger southeast along the chain; their K-Ar ages and dimensions of islands and calderas are tabulated. Oldest fossils, from drill holes in Midway and dredged just south of Oahu, are Miocene in age. Isostatic downwarping of the crust, averaging about 12,000 feet under the main ridge, created a trough around the islands; shoreline both above and below sea level record tectonic changes and Pleistocene fluctuations. Lavas from renewed post-Pleistocene eruptions differ chemically from early dome lavas. Mauna Loa and Kilauea volcanoes have erupted nearly a cubic mile of lava since 1923, Mauna Kea has produced flows since its glaciation in the Wisconsin epoch, and Haleakala last erupted in 1790. Features to be seen along roads of five islands are described.—G.D.C.

Stearns, Richard G. *See* Wilson, Charles W., Jr. 8520

8528 **Steenland, Nelson C.** Reply [to discussion by W. C. Kellogg, 1966, of "Oil fields and aeromagnetic anomalies," 1965]: Geophysics, v. 31, no. 4, p. 826, 1966.

The disadvantages in high-sensitivity aeromagnetic surveying referred to by Kellogg in his criticism (ibid., p. 824–826, 1966) are outweighed by the advantages; the problems described are not regarded as insoluble.—D.B.V.

8473 **Steinhoff, R. O.** Geology of South Bosco–Duson–Ridge area, Acadia and Lafayette Parishes, Louisiana [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2319–2320, 1966.

Stephens, Howard D. *See* Scott, Cloyd H. 8874

Stevens, A. E. *See* Hodgson, J. H. 8662

8341 **Stewart, John H.; Ross, Donald C.; Nelson, C. A.; Burchfiel, B. C.** Last Chance thrust—A major fault in the eastern part of Inyo County, California, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D23–D34, illus., table, 1966.

The Last Chance thrust has been traced throughout an area of over 400 sq mi in the eastern part of Inyo County, Calif., and probably extends in the subsurface under most of the northern Inyo Mountains and southern White Mountains. Late Precambrian, Cambrian, or Ordovician strata form the sole of the upper plate and are thrust over shaly Mississippian strata, and locally carbonate rocks of Silurian age. The strata in the upper plate generally dip eastward into the fault surface, exposing successively younger strata above the fault to the east. These spatial relations show that the upper plate moved east relative to the lower plate for a minimum distance of 20 miles.—Authors' abstract

Stramel, G. J. *See* Albert, C. D. 8887

Straw, W. Thomas. *See* Carr, Donald C. 8803

8542 **Stringfield, V. T.** Hydrogeology—Definition and application: Ground Water, v. 4, no. 4, p. 2–4, 1966.

One of the earliest uses of the word *hydrogeology* was by J. B. Lamarcke (1802) in his book, Hydrogeologie. He regarded hydrogeology as covering all research on the influence of waters on the surface of the Earth and including origin of the ocean. At present in Europe it is used in a more restricted sense. The growth of the International Association of Hydrogeologists and of the Hydrogeology Division of the Geological Society of America is traced. The hydrogeology–geohydrology controversy and practice of the science are discussed.—E.S.L.

Sutherland, Alex J. *See* Flaxman, Elliott M. 8697

8670 **Swanson, Donald C.** Major factors controlling Anadarko basin production: World Oil, v. 164, no. 1, p. 81–92, illus., 1967.

Many major oil and gas fields in the Anadarko basin, Texas, Oklahoma, and Kansas, occur in anticlinal or stratigraphic traps on the structural periphery of the basin. Hydrocarbons generated in the basin migrated updip toward the periphery. Isopach and lithofacies maps of Pennsylvanian strata delineate embayments on the basin flank and outline hinge zone and shelf areas. Embayments are locations of abrupt strike changes, could have been broad traps for petroleum, and could be sites of deltaic sedimentation which are often associated with hydrocarbon accumulation. On the hinge zone occur rapid facies changes and onlap and truncated edges of sediments. This zone of anomalous stratigraphic changes is a favorable locale for hydrocarbon accumulation.—M.W.R.

8447 **Takeuchi, Hitoshi; Kanamori, Hiroo.** Equations of state of matter from shock wave experiments: Jour. Geophys. Research, v. 71, no. 16, p. 3985–3994, illus., tables, 1966.

The Mie–Grüneisen equation of state combined with the Slater or Dugdale–MacDonald formula for the Grüneisen ratio can be used to interpret the Hugoniot P–v relation in terms of the equation of state. The result thus obtained for iron is in good agreement with results based on an experimentally determined Grüneisen's ratio. The Earth's core is about 1 to 1.5 g per cm^3 less dense than iron at corresponding pressure and temperature, while the difference in incompressibility is slight. The variation of incompressibility among metals studied here is too large to support Bullen's incompressibility–pressure hypothesis, but it is still difficult to avoid the conclusion that the inner core is solid.—D.B.V.

Tandanand, Sathit. *See* Paone, James. 8500

8516 **Texas Water Development Board.** Texas Water Development Board list of publications: Texas Water Devel. Board Circ. 2, 50 p., illus., 1966.

In September 1965 a realignment of water organizations in Texas resulted in creation of the Texas Water Development Board; this circular lists only those publications held and distributed by that board. It contains listings of all bulletins, circulars, memorandum reports, limited-distribution reports, and water-resources planning reports formerly printed and distributed by its predecessors, as well as most reports of the State Reclamation Department, in addition to the reports, circulars and planning series printed since September 1965. Some publications are out of print but are available for review in the library of the Water Development Board. M.C.M.

Thomas, H. H. *See* Philpotts, John A. 8738

8749 **Thompson, Robert R.; Creath, Wilgus B.** Low molecular weight hydrocarbons in Recent and fossil shells: Geochim. et Cosmochim. Acta, v. 30, no. 11, p. 1137–1152, illus., tables, 1966.

The amounts of the C_1–C_5 hydrocarbons in shells increase with increasing geologic age; typical amounts range from about 0.05 μ g per g of shell in modern shells to 7.5 μ g per g in an Ordovician shell. The C_1–C_5 hydrocarbons start increasing very soon after the deaths of the shell organisms. Different hydrocarbon distributions in fossil shells of different taxa from the same location, as well as in fossil shells compared to the enclosing sediments, indicates that the principal source of the hydrocarbons is the organic matter in the shell structure. Thus shells may be particularly suitable for studying the formation of the light hydrocarbons under geologic conditions.—D.B.V.

8723 **Thurston, William.** U.S. Geological Survey's aids to teachers and students: Jour. Geol. Education, v. 14, no. 4, p. 135–136, 1966.

This article indicates briefly the contents of the 12 most generally useful unpublished lists of educational material compiled by those offices that regularly answer letters from the public.—E.S.L.

8355 **Tibbetts, Benton L.; Dunrud, C. Richard; Osterwald, Frank W.** Seismic-refraction measurements at Sunnyside, Utah, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D132–D137, illus., 1966.

Three reversed seismic-refraction profiles were recorded in the Sunnyside, Utah, area in August 1965. The average velocity of the seismic waves is 4.3 km/sec through the Mesozoic and lower Tertiary sedimentary rocks and an average of 6.0 km/sec along the upper portion of the Paleozoic carbonate rocks. The thickness of sediments that overlie the upper Paleozoic carbonate refractor horizon ranges from 1.2 km in Clark Valley to 3.7 km in Range Creek.—Authors' abstract

8829 **Tilles, David.** Implantation in interplanetary dust of rare-gas ions from solar flares: Science, v. 153, no. 3739, p. 981–985, illus., tables, 1966.

Measurements of excess Ar-36 and Ar-38 (released mainly at 1200°C) in magnetic concentrates of Pacific sediments and in a dense concentrate of Greenland dust agree within an order of magnitude with expected concentrations implanted by solar-flare ion streams of energy less than 10 Mev per atomic-mass unit. The agreement implies that more than 10 percent of each concentrate may be extraterrestrial, depending on size distribution and flare spectrums. Among other things, rare-gas measurements on fine-grained dust can provide data on interplanetary dust influx rates and sedimentation rates of oceanic cores.—D.B.V.

8870 **Ting, William S.** Determination of Pinus species by pollen statistics: California Univ. Pubs. Geol. Sci., v. 58, 182 p., illus., tables, 1966.

Species of California pines can be identified by statistical pollen analysis of samples containing as many as three mixed species. Acetolysis and glycerine-jelly mounts are used in specimen preparation. Breadth of corpus, breadth of saccus, and overall breadth are measured. A new index—the cos A index—is based on three ratios of the three measurements, and is highly discriminating for specific identification.—W.P.I.

8731 **Todd, Ruth.** Recent literature on the Foraminifera: Cushman Found. Foram. Research Contr., v. 17, pt. 1, p. 33-41, 1966; ibid., pt. 2, p. 72-75, 1966; ibid., pt. 3, p. 109-116, 1966; ibid., pt. 4, p. 150-158, 1966.

8806 **Todd, Ruth.** Smaller Foraminifera from Guam: U.S. Geol. Survey Prof. Paper 403-I, p. I1-I41, illus., tables, 1966.

Rich and predominantly planktonic assemblages of smaller Foraminifera are tabulated and illustrated from two Upper Eocene samples (Tertiary *b*) in the Alutom Formation, four Lower Oligocene samples (Tertiary *c*) in the Mahlac Member of the Alutom Formation, and seven Miocene samples (Tertiary *f* or *g*) in the Janum Formation. Study of species from beaches, reefs, lagoons, channels, and outer slopes around Guam (98 samples) provides a basis for paleoecologic interpretation of moderately deep outer-slope deposition in the three formations studied.—R.T.

8775 **Toomey, Donald Francis.** Annotated bibliography of Paleozoic nonfusulinid Foraminifera, Addendum 3: Cushman Found. Foram. Research Contr., v. 17, pt. 2, p. 46-66, 1966.

The addendum includes 115 annotated references pertaining to Paleozoic nonfusulinid Foraminifera and can be considered reasonably complete through the year 1963. As in previous bibliographies (Toomey, 1959, 1961, 1963, 1965), the aims are unchanged: (1) to summarize briefly the pertinent data contained in each article, (2) to list all new genera and species described therein, and (3) to denote, by brackets, all taxonomic changes noted from subsequent publications,thus making the bibliography a more useful working tool. An attempt is also made to evaluate the literature to date and possibly to delineate trends.—Author's abstract

Toulmin, L. D. *See* Newton, J. G. 8676

8398 **Town, J. W.** Petrographic and flotation studies on the Meade Peak, Idaho, phosphate samples: U.S. Bur. Mines Rept. Inv. 6751, 16 p., illus., tables, 1966.

Ore grade, ovule size, and clay content are the main features affecting grade and recovery of phosphate. Flotation results on roasted ore with a tall oil emulsion scheme showed that beds containing over 10 percent P_2O_5 can be beneficiated and composited with the two high-grade beds to produce a composite concentrate containing 31.9 percent P_2O_5 at 84.3 percent recovery. Treatment of these intermediate-grade phosphate beds by flotation increases ore reserves over 200 percent and increases the ore-to-waste ratio in the ore zone from 1:5.7 to 1:0.27. Textural and compositional features, qualitative spectral analyses, chemical analyses, and mineralogical composition are given in tables.—H.R.B.

8450 **Triplehorn, D. M.** Morphology, internal structure, and origin of glauconite pellets: Sedimentology, v. 6, no. 4, p. 247-266, illus., 1966.

About 75 samples of Cambrian–Tertiary glauconite pellets from the United States were examined. Morphological types are: ovoidal or spheroidal, tabular or discoidal, mammillated, ellipsoidal, vermicular, composite, and fossil casts (internal molds). Types of internal structures include: random and oriented microcrystalline, micaceous, organic(?) replacements, coatings on detrital grains, and fibroradiated rims. The majority of pellets are spheroidal or ovoidal with random cryptocrystalline internal structures, and could result from a number of processes. However many of the morphologies and structures described may provide information concerning formation of glauconite and its history. Triplehorn agrees with the concept that the immediate precursor of glauconite is a degraded illite or montmorillonite-like material. Seventeen samples are illustrated and locations and descriptions are included in an appendix.—E.S.L.

8852 **Tschudy, Robert H.** Associated megaspores and microspores of the Cretaceous genus *Ariadnaesporites* Potonié, 1956, emend, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D76–D82, illus., 1966.

A sample from the Tuscaloosa Formation of Alabama yielded many specimens of a new species of *Ariadnaesporites* Potonié, 1956. Morphologically similar large and small spores, found in masses, were joined by intertwined long distal hairlike appendages. As these two spore types probably represent megaspores and microspores of the same species, they are both described under the name *Ariadnaesporites cristatus*, n. sp. The presence of leaflike extensions (here named acrolamellae) of the lips of the laesurae on the first-described member of the genus, *Ariadnaesporites ariadnae*, had not been noted previously. Emendation of the genus is presented.—Author's abstract

8846 **Turcan, A. N., Jr.; Wesselman, J. B.; Kilburn, Chabot.** Interstate correlation of aquifers, southwestern Louisiana and southeastern Texas, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D231–D236, illus., table, 1966.

Three major aquifers—the Chicot, Evangeline, and Jasper—and two aquicludes—the Burkeville and one as yet unnamed—are recognized on an interstate basis in part of the Louisiana–Texas Gulf Coast region. These hydrologic units consist of sediments of Miocene, Pliocene, and Pleistocene ages. Wells tapping the aquifers supply about a billion gallons of water per day for industrial, agricultural, and municipal use.—Authors' abstract

8416 **Turekian, Karl K.; Imbrie, John.** The distribution of trace elements in deep-sea sediments of the Atlantic Ocean: Earth and Planetary Sci. Letters, v. 1, no. 4, p. 161–168, illus., tables, 1966.

The distribution of barium, cobalt, copper, nickel, lead, chromium, manganese and tin have been determined in the tops of deep-sea cores from the Atlantic Ocean. The trace elements show no correlations with clay mineralogy or depth of water. The strongest correlations are: (1) among manganese, nickel and cobalt which can be related generally to areas of low clay accumulation rates hence possibly representing a fine grained pelagic component, and (2) the correlation of copper with calcium carbonate.—Authors' abstract

8680 **Turekian, Karl K.; Johnson, David G.** The barium distribution in sea water: Geochim. et Cosmochim. Acta, v. 30, no. 11, p. 1153–1174, illus., tables, 1966.

Results of more than 250 determinations of Ba concentration in sea water from widely distributed areas indicate that there is no universal correlation between the distribution of Ba in oceanic profile and the concentration in deep-sea sediments. Some correlation of Ba with Ra distribution appears to exist in the Caribbean Sea, but similar correlation is doubtful in the eastern Pacific. The major feature of oceanic Ba distribution is the narrow dispersion of concentrations. Barium is not removed in any significant manner in near-shore areas; it is mainly in deep-sea sediments, probably as barite, but all the various sources and paths of Ba in the oceans are not yet clearly defined.—D.B.V.

8770 **Turnbull, Willard J.; Krinitzsky, Ellis L.; Weaver, Frank J.** Bank erosion in soils of the Lower Mississippi Valley: Am. Soc. Civil Engineers Proc., v. 92, paper 4632, Jour. Soil Mechanics and Found. Div., no. SM 1, p. 121–136, illus., tables, 1966.

Bank erosion along the lower Mississippi depends on the tendencies of the river to meander and on the geology of the banks. In the alluvial valley, the river erodes its thalweg in sands, and sands and gravels. During high stages, bendway pools may be deepened 20 to 40 feet or more, steepening the toes of banks and causing subaqueous failures, which trigger upper bank failures. In the deltaic plain, the river erodes its thalweg chiefly in clays. Here the surge of water during the high stage is reduced by distributaries, and erosion is further reduced by the cohesive strength of the clays. The major sedimentary deposits are tabulated and a map shows their distribution.—E.S.L.

Ueno, S. *See* Noguchi, K. 8576

Ueno, S. *See* Noguchi, K. 8577

Untermann, B. R. *See* Untermann, G. E. 8703

8703 **Untermann, G. E.; Untermann, B. R.** Field guide to the geology of the Uinta Mountains and adjacent synclinal basins: Utah Geol. and Mineralog. Survey Earth Sci. Education Ser. 1, 12 p., illus. [1966?].

The Uinta Mountains of northeastern Utah are the major east–west trending range in the western hemisphere. They represent an anticlinal fold approximately 150 mi long by 50 mi wide, consisting chiefly of sedimentary rocks that range in age from Precambrian to Cenozoic. The 26 major formations are described briefly and the fossils listed. The range was initially uplifted near the close of the Cretaceous, followed by periods of elevation and faulting during the Tertiary. Maximum displacement along the north side is more than 30,000 feet, and along the south side, several thousand.—E.S.L.

8811 **Urey, Harold C.; Arnold, James R.** Biological materials in carbonaceous chondrites, Chap. 4 *in* Biology and the exploration of Mars: Natl. Acad. Sci.—Natl. Research Council Pub. 1296, p. 114–124, tables, 1966.

Water necessary for the evolution of life on Mars must have escaped into space; subsequent erosion should have produced sedimentary rocks; if carbonaceous chondrites could have been removed from Mars, so should the sedimentary rocks. No such meteorites have been observed; the energy required to remove objects from Mars is a little less unreasonably large than that of Earth. All three types of carbonaceous chondrites contain some carbon. Two of them have substantial amounts of water and little metal; other than sulfur, water and carbon, the element composition is similar to a high iron group chondrite. Lack of sorting is evident, either by water or by melting. The carbonaceous chondrites are not similar to any known rock types, but have abundances of rarer elements such as expected of solar abundances. They must come from asteroids or the Moon.—G.D.C.

8754 **Utah Geol. and Mineralog. Survey.** (compiler). Gold placers in Utah—A compilation: Utah Geol. and Mineralog. Survey Circ. 47, 29 p., 1966.

Of the small amount of published material concerning placer mining in Utah, most is out-of-print and available only in libraries. Only one publication, Utah Geol. and Mineralog. Survey Bull. 62, is still available. Seven bulletins and professional papers of the U.S. Geological Survey are listed, most of which discuss placer operations on the Green, Colorado, and San Juan Rivers, and adjacent areas around the Henry and La Sal Mountains, and placer mining in the Bingham district. Except for illustrations, those sections that describe Utah gold placers are herein reproduced. Commercial placer operations in Utah have been discouraging or unsuccessful, but there are extensive areas, some along stream courses draining major mining districts, that have not been thoroughly prospected for gold. In many areas lack of water is a serious handicap.—G.D.C.

Uyeda, S. *See* Vacquier, V. 8568

8568 **Vacquier, V.; Richards, M.; Uyeda, S.** Palaeomagnetism of Pacific seamounts [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Div. Mtg. Solid Earth Physics II, p. 3, 1966.

8658 **Vacquier, V.** Geomagnetic and geothermal surveys in the Pacific [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Symposium, no. 10, p. 11, 1966.

VanLieu, J. A. *See* Keefer, W. R. 8804

8487 **VanMorkhoven, F.P.C.M.** Concept of paleoecology and its practical application [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2325, 1966.

8385 **Veevers, J. J.; Jackson, J. W.** Improved field device for recording stratigraphic sections: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 11, p. 2470–2472, illus., 1966.

A new device for holding a strip log for use in direct plotting while in the field is described.—S.P.S.

8791 **Vine, F. J.** Spreading of the ocean floor—New evidence: Science, v. 154, no. 3755, p. 1405–1415, illus., 1966.

The extreme linearity and continuity of oceanic magnetic anomalies and their symmetry about the axes of oceanic ridges suggests that variations in intensity and polarity of the geomagnetic field are recorded in the remanent magnetization of the igneous rocks as they form at the crest of a ridge and spread away from it at a steady rate. If the proposed magnetic time scale for the last four million years is combined with this model, computed anomaly profiles show remarkably good agreement with those observed, and deduced rates of spreading are in exact agreement with those needed to account for continental drift. Within the framework of ocean floor spreading, magnetic anomalies may indicate the nature of fracture zones and distinguish parts of the ridge system that are actively spreading.—D.B.V.

8688 **Vita, O. A.** The separation and microanalysis of niobium, tantalum, titanium, vanadium, and zirconium—Application to uranium compounds: Goodyear Atomic Corp., Piketon, Ohio, Rept. GAT-524, 15 p., illus., tables, 1966.

The N-benzoylphenylhydroxylamine (BPHA) complexes of these elements are extracted into chloroform, as a group from 10*N* HCl solutions, which separates them from gross quantities of uranium and many other elements, including rare earths. After the separation, the purified Nb, Ta, Ti, V, and Zr can be determined by suitable chemical or spectrographic procedures. A spectrochemical procedure is presented for the simultaneous determination of microgram quantities of Nb, Ta, Ti, and Zr in uranium compounds.—E.S.L.

8566 **Vorhis, R. C.** Hydrologic effects outside Alaska of the March 27, 1964 earthquake [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Div. Mtg. Solid Earth Physics I, p. 44, 1966.

8397 **Waddell, G. G.** In-situ measurement of rock deformation in a vein-type deep mine: U.S. Bur. Mines Rept. Inv. 6747, 47 p., illus., 1966.

Detailed descriptions are given of down-the-hole extensometers, floating rockbolt clusters, transit surveys, and other instruments and measuring techniques. The most useful radial-deformation-rate data were obtained with radial extensometers that penetrated, to various depths, the rock around access openings. An analysis is given of measurement data on the rock around lateral drifts and across and adjacent to the nearly vertical vein of the Star mine, Burke, Idaho. Information was produced on the elastic state of rock around an underground opening, effectiveness of stope support, rheology of rock, zone of influence around stopes, effectiveness of rockbolts, axis of maximum strain in a plane perpendicular to the long axis of the lateral, and other phenomena.—H.R.B.

8538 **Wagner, W. R.** Pennsylvanians must delve into rocks of ancient age: Oil and Gas Jour., v. 64, no. 50, p. 152–158, 1966.

Natural gas is produced from two wells on the Waverly arch in northwestern Pennsylvania from sandstone and carbonate rock of the Upper Cambrian Gatesburg Formation, which is overlain by the argillaceous Lower Ordovician Shadow Lake Formation. Entrapment of natural gas is found where porous zones of the Gatesburg intersect the unconformable surface. Producing areas are further localized by irregularities of the unconformable surface and by faulting. Primary porosity in the Gatesburg was probably enhanced near the unconformable surface by weathering during Early Ordovician time. The Upper Cambrian may also contain petroleum in other parts of Pennsylvania, particularly south and east of Crawford County.—K.A.D.

8497 **Wagner, Walter R.** Stratigraphy of the Cambrian to Middle Ordovician rocks of central and western Pennsylvania: Pennsylvania Geol. Survey, 4th ser., Bull. G 49 (General Geology Rept.), 156 p., table, 1966.

Subsurface strata of western Pennsylvania are correlated with centrally outcropping formations of the Nittany arch belt by means of studies of drill cuttings, insoluble residues, and gamma ray logs. Well samples from 13 sections are described in an appendix. The western Cambrian is divided by three sandstone units. Lower Ordovician carbonates thin from 4,000 feet in the outcrop area to extinction in the northwest corner; regional stratigraphy is based on six sandy carbonate zones. The major unconformity is in the Nittany Formation, throughout the area except for the northern arch and the southern Great Valley. Subsurface Middle Ordovician limestones are similar to a number of the correlated outcropping formations. In northwestern counties the Coburn and part of the Salona are replaced by dark shales derived from the Ozark dome.—G.D.C.

Wagner, Walter R. *See* Lytle, William S. 8713

8715 **Wagner, Walter R.** Bedford County Oriskany (Ridgeley) gas fields, *in* Oil and gas developments in Pennsylvania in 1965: Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 172, p. 44–48, illus., 1966.

Gas was first discovered in the Purcell field in 1957; since then three new gas fields and one new gas pool have been found. The fields are located on thrust-faulted anticlines within the Broad Top synclinorium and faults often control the boundaries; every well crosses at least one fault. The fields are described, and structure contour maps included.—E.S.L.

Wahrhaftig, Clyde. *See* Oakeshott, Gordon B. 8744

8823 **Waldschmidt, W. A.** Geologic framework of the Permian Basin, *in* Oil and gas fields in West Texas—Symposium: West Texas Geol. Soc. Pub. 66–52, p. 7–9, 1966.

The major structural features of the Permian basin in Texas are the Central basin platform, Delaware basin, Midland basin and Eastern shelf, Ozona platform, Val Verde basin, and Marfa basin. The structure and stratigraphy of each are reviewed.—E.S.L.

Walker, D. A. *See* Kroenke, L. W. 8553

8560 **Walker, D. A.** The observation and analysis of body waves recorded in the northwestern Pacific [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Div. Mtg. Solid Earth Physics I, p. 28, 1966.

8494 **Wallace, W. E.** Fault and salt map of south Louisiana [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2327, 1966.

8541 **Walton, W. C.** Hydrogeologic aspects of the International Hydrological Decade: Ground Water, v. 4, no. 4, p. 36–47, 1966.

The IHD program (1965–74) will consist primarily of activities of the 90 participating countries coordinated and supplemented by international agencies and scientific associations. The five major study objectives are large-scale balances of water and water-borne material; hydrological performance of river, lake, and ground-water basin systems; specific hydrological processes and their variations in time, and improvement of methods and techniques; education and training; and services providing coordination and administration support. The hydrogeologic activities of a provisional US/IHD program are listed, and hydrogeologists are urged to submit proposals concerning possible activities for inclusion. Seven criteria which guide the U.S. National Committee in formulation and inclusion of activities are given.—*from* Author's abstract

8437 **Wang, Fun-Den.** The strength alteration of rocks and glass in liquid environments [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 847B, 1966.

Ward, S. H. *See* Goldstein, N. E. 8403

8830 **Wasson, John T.** Butler, Missouri—An iron meteorite with extremely high germanium content: Science, v. 153, no. 3739, p. 976–978, table, 1966.

The Butler iron meteorite has been found to have a germanium concentration of 2,000 ppm, which is about five times higher than the highest concentration that has been measured previously in an iron meteorite. The gallium concentration is 87 ppm, which is among the highest concentrations found in these objects. The nickel content is 16.0 percent, the second highest nickel concentration known in a meteorite displaying a Widmanstätten pattern. The high Ge/Ni ratio, as well as the association of a high nickel content with high gallium and germanium contents, make this object an exception to two geochemical generalizations regarding the iron meteorites.—Author's abstract

8871 **Watson, K. K.** An instantaneous profile method for determining the hydraulic conductivity of unsaturated porous materials: Water Resources Research, v. 2, no. 4, p. 709–715, illus., table, 1966.

The hydraulic conductivity-water content relationship, as used in the differential equation describing unsteady flow in unsaturated porous materials, is determined from measurements obtained during the drainage of an initially saturated sand column. The approach utilizes instantaneous profiles of the macroscopic flow velocity, the potential gradient, and the water content. The derived relationship exhibits a direct proportionality between the instantaneous velocity and the corresponding potential gradient, thus lending strong support to the contention that Darcy's law is applicable to flow in unsaturated porous materials of the size range considered in this study.—Author's abstract

Weaver, Frank J. *See* Turnbull, Willard J. 8770

Webb, William. *See* Carr, Donald C. 8803

8495 **Weddle, James R.** Northeast area of McKittrick oil field: California Div. Oil and Gas, California Oil Fields—Summ. Operations 1965, v. 51, no. 2, p. 5–20, illus., tables, 1966.

About 10,500 feet of clastic rocks have been penetrated in the Northeast area of McKittrick field; the sequence, present throughout the area, comprises a nearly complete stratigraphic column from upper Eocene through Pleistocene; basement rock has not been reached in any well. The field is near the western edge of the Tulare basin in a region of moderate to intense folding and faulting. The producing zones in the area are the Tulare-Olig (depth 765 feet), Antelope Shale, Carneros, Phacoides, Oceanic, and Point of Rocks (9,145 feet); the Phacoides and Oceanic are the most productive. Known reserves of the area are large.—M.C.M.

Weiss, Martin. *See* Melik, James C. 8820

8721 **Wells, Philip V.** Late Pleistocene vegetation and degree of pluvial climatic change in the Chihuahuan Desert: Science, v. 153, no. 3739, p. 970–975, illus., table, 1966.

Fossil vegetation from eight Pleistocene wood rat middens at elevations of 1,200, 880, and 600 m in the Chihuahuan Desert in western Texas includes species indicating xerophilous woodland vegetation in the lowlands, as much as 800 m below existing woodland, during the Wisconsin pluvial. Radiocarbon dates range from 11,560 to 14,800, and 16,250 to 20,000, and to more than 40,000 years. Disjunct distribution of montane species on isolated peaks is attributed to long-distance transportation of propagules, rather than to former continuity during the pluvial phase.—D.B.V.

Wesselman, J. B. *See* Turcan, A. N., Jr. 8846

8826 **West Texas Geological Society.** Oil and gas fields in West Texas—Symposium: West Texas Geol. Soc. Pub. 66-52, 398 p., illus., tables, 1966.

The publication is intended as a reference for those engaged in the search for new reserves or more efficient oil and gas production in the Permian basin; data sheets on 97 fields, with structure contour maps, cross sections, and logs, are included. The loose-leaf format is used so that more information can be added. A correlation chart of the Paleozoic in major areas of western Texas is given. Four general papers on the basin are cited separately.—E.S.L.

West, Walter S. *See* Whitlow, Jesse W. 8798

8376 **Western Miner.** Underground operations of Texada Mines, Ltd.: Western Miner, v. 39, no. 11, p. 30-36, 1966.

Skarn deposits on Texada Island, British Columbia, contain magnetite, chalcopyrite, marcasite, and pyrrhotite. Late Triassic basalts and limestone were intruded by granodiorite and feldspar porphyry, and skarn and mineral zones formed along the limestone-granodiorite and basalt-limestone contacts. Production from several deposits totals 4,000 tons per day.—A.R.K.

8810 **Weyl, Richard.** The paleogeographic development of the Central American-West Indian region [translated from German]: Bol. Inf., v. 9, no. 4, p. 99-120, illus., 1966; originally published 1965.

This is a translation of "Die paläogeographische Entwicklung des mittelamericanisch-westindischen Raumes" published in Geol. Rundschau, v. 54, no. 2, p. 1213-1240, 1965.—M.C.M.

8481 **White, B. Ross; Sawyer, Jerry R.** Black Lake field—Before and after [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2323, 1966.

8395 **White, E. J.; Baptist, O. C.** Laboratory evaluation of flow characteristics of oil-producing sandstones in Illinois, Indiana, and Kentucky: U.S. Bur. Mines Rept. Inv. 6804, 20 p., illus., tables, 1966.

From tests of cores from 35 wells in 14 oil-producing zones, all containing only minor amounts of clay minerals, it is concluded that permeability reduction results from movement of dislodged silica particles and other materials, including clays, which line the pores. Most samples had only low to moderate water sensitivity, so that permeability reduction due to such particle movement should usually not be of practical significance. The effective permeability to water was considerably lower than the effective permeability to oil during two-phase flow measurements, as is typical of most reservoir rocks. Relatively high injection pressures will therefore be required in water-flooding thin zones or zones having low permeabilities. Physical properties and clay mineral content of the sandstones are tabulated.—H.R.B.

8660 **White, W. R. H.** On the structure of the Earth's crust on the western coast of Canada [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Symposium, no. 10, p. 17, 1966.

White, Walter S. *See* Books, Kenneth G. 8353

8798 **Whitlow, Jesse W.; West, Walter S.** Geology of the Potosi quadrangle, Grant County, Wisconsin, and Dubuque County, Iowa: U.S. Geol. Survey Bull. 1123-I, p. 533-571, illus., geol. map, 1966.

Mapping of the Potosi 7 1/2-minute quadrangle was undertaken to study in detail the relation of geologic features to the mineralized areas in the Upper Mississippi Valley zinc-lead district as a guide to exploration for zinc and lead minerals and other materials. Structure and stratigraphy of the Lower to Upper Ordovician rocks and the clastic dikes of unknown age were studied. The Piquette No. 2 ore body near Tennyson, Wis., was mapped. Economic geology and ore-production potential of the metallic and nonmetallic deposits are discussed.—J.W.W.

Whitmore, Sharyn. *See* Bieberman, Robert A. 8729

8661 **Whitten, C. A.** Geodetic measurements for the study of crustal movements [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Symposium, no. 10, p. 19, 1966.

Wickens, A. J. *See* Hodgson, J. H. 8662

8342 **Wiesnet, Donald R.; Clark, Thomas H.** The bedrock structure of Covey Hill and vicinity, northern New York and southern Quebec, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D35-D38, illus., 1966.

Covey Hill, which lies on the international border between Quebec and New York, is bordered on the east by the north-trending Havelock fault and on the north by the east-trending Stockwell fault. The Havelock, a rotational, or pivotal fault has its hinge point at or very near the international border. Southward from the hinge point the fault plane presumably dips west, and the upthrown side is on the east; northward from the hinge point the fault plane presumably dips east, and the upthrown side is on the west. A buried ridge of Precambrian rock may account for localization of the faulting, which probably is Taconic in age.—Authors' abstract

8454 **Wilband, John Truax.** Geochemistry and origin of the Wheatland Sericite deposit, Platte County, Wyoming [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 861B, 1966.

8472 **Wilbert, William Pope.** Stratigraphy of Georgetown Formation, central Texas [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2319, 1966.

8506 **Wilkinson, Elbert R.** McCool Ranch oil field: California Div. Oil and Gas, California Oil Fields—Summ. Operations 1965, v. 51, no. 2, p. 75-80, illus., table, 1966.

McCool Ranch field lies within the Salinas Valley, an elongated synclinal depression, here divided into two depositional areas: eastern, overlain by upper Miocene to Pliocene sediments; and western, containing several thousand feet of Oligocene to Recent sediments. Division between the two areas is believed caused by extensive movement along the King City fault. Oldest rock is the Jurassic Santa Lucia granodiorite, overlain by Miocene Monterey and Santa Margarita Formations, Pliocene Poncho Rico and Paso Robles. Productive limits of the Lombardi sand have been defined to the east where the sand onlaps the rising basement surface forming stratigraphic closure, and to the west by an oil-water contact. A decrease in permeability to the north has created an effective barrier to migration in this direction.—M.C.M.

8666 **Williamson, D. R.** Exploration for diatomites: Colorado School Mines Mineral Industries Bull., v. 9, no. 3, 14 p., illus., tables, 1966.

It should be possible to deduce conditions necessary for accumulation of large Tertiary deposits of diatomites from present and Recent diatoms; abundant data on distribution is available. It must be an area which is being neither degraded nor aggraded, where aquatic plant life is abundantly possible, where conditions are favorable for exclusion of contaminants, and where the subsequent geologic history is favorable for protection and beneficiation of the deposit. In terrestrial

environments, commercial diatomite deposits are most likely to be found in lacustrine strata; criteria definitive of such strata are discussed, including categories, sequences, and physical character of strata, and mineralogy of the deposit. Maps showing known Pleistocene, Tertiary, and pre-Tertiary lake deposits in the western United States are included. Ocean deposits are reviewed briefly.—E.S.L.

8520 **Wilson, Charles W., Jr.; Stearns, Richard G.** Circumferential faulting around Wells Creek Basin, Houston and Stewart Counties, Tennessee—A manuscript by J. M. Safford and W. T. Lander, circa 1895: Tennessee Acad. Sci. Jour., v. 41, no. 1, p. 37–48, illus., 1966; reprinted as Tennessee Div. Geology Inf. Circ. 15, 1966.

From early maps and publications by Stafford, then State Geologist of Tennessee, it is inferred that he became acquainted with the Wells Creek Basin faulting between 1855 and 1869. Later field work with Lander culminated in a long-lost manuscript accompanied by a geologic map and cross sections which is probably the first detailed geologic report on a cryptoexplosive structure in the United States. Written as a guidebook, it is presented unchanged here, along with contrast in present terminology and comparison with presently understood fault pattern. Current investigations by Wilson and Stearns have revealed the presence of a fourth fault around the structure rather than the three originally connected through scant exposures on the east and west sides.—G.D.C.

8692 **Wilson, Charles W., Jr.** Geologic map of the Sandy Hook quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 58-NW, scale 1:24,000, separate text, 1966.

The accompanying text, "Mineral resources summary of the Sandy Hook quadrangle, Tennessee," by R. H. Barnes is cited separately.—M.C.M.

8693 **Wilson, Charles W., Jr.** Geologic map of the Nashville East quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 311-NW, scale 1:24,000, separate text, 1966.

The accompanying text, "Mineral resources summary of the Nashville East quadrangle, Tennessee," by C. W. Wilson, Jr. and D. S. Fullerton is cited separately.—M.C.M.

8695 **Wilson, Charles W., Jr.; Fullerton, Donald S.** Mineral resources summary of the Nashville East quadrangle, Tennessee: Nashville, Tennessee Div. Geology, 13 p., 1966.

This text accompanies Tennessee Div. Geology Geol. Map GM 311-NW by C. W. Wilson, Jr. (cited separately). Mineral resources mined in the Nashville East quadrangle are limestone from the Carters and Bigby-Cannon Limestones and the Leipers and Catheys Formations; phosphate from the Bigby-Cannon; sand and gravel from alluvial deposits along the Cumberland River and its larger tributaries; and some barite, fluorite, and galena.—M.C.M.

8378 **Winslow, A. G.** William Owsley George (1892–1966): Am. Assoc. Petroleum Geologists Bull., v. 50, no. 11, p. 2482, portrait, 1966.

Witherspoon, P. A. *See* Freeze, R. Allan, 8894

8840 **Withington, C. F.** A potential source of brick clay in the Beltsville area, Prince Georges and Montgomery Counties, Maryland, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D203–D208, illus., tables, 1966.

Bricks have been made successfully in the laboratory from silty clay that accumulates as waste material in sediment ponds of gravel-washing plants near Beltsville, Md. The composition of the clay compares favorably with the raw material now being used commercially for common brick. The laboratory brick fires light pink and hard to very hard, at temperatures of 1,900°F to 2,000°F. If further tests show that the waste material can be used commercially for making brick, it may form the basis for a new source of brick in the Beltsville area.—Author's abstract

8733 **Woodburne, Michael O.** Equid remains from the Sonoma volcanics, California: Southern California Acad. Sci. Bull., v. 65, no. 3, p. 185–189, illus., 1966.

An upper molar and a third metatarsal, here assigned to a moderately small, primitive unnamed species of *Equus*, subgenus *Plesippus*, have been found in tuffaceous rocks probably representing the Sonoma volcanics, south of Calistoga, Napa County, Calif. The fossils are important in that they indicate a probable Blancan (late Pliocene or early Pleistocene) age for the rocks.—V.M.J.

8555 **Woollard, G. P.** The relation of gravity anomalies to crustal structure and geology in the United States [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Div. Mtg. Solid Earth Physics I, p. 9, 1966.

8556 **Woollard, G. P.** Gravity relations to geology and topography in Central America [abs.], *in* Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 3: Tokyo, Sci. Council Japan, Div. Mtg. Solid Earth Physics I, p. 10, 1966.

Woollard, G. P. *See* Kroenke, L. W. 8557

Woollard, G. P. *See* Manghnani, M. H. 8558

8431 **Yasso, Warren E.** Formulation and use of fluorescent tracer coatings in sediment transport studies: Sedimentology, v. 6, no. 4, p. 287–301, illus., tables, 1966.

Extensive sediment sampling in particle transport studies possibly may be eliminated by measuring light emission from coated particles under near-ultraviolet excitation. Testing of five commercial coatings led to formulation of two additional coatings; all are insoluble in fresh or saline water, and volume production of marked particles in the field is possible. A battery-operated portable photometer was assembled, which indicates five percent differences in concentration of marked particles. A profile normal to spit-bars at Horseshoe Cove, Sandy Hook, New Jersey, was selected for investigation of foreshore sediment transport, using color-coded sizes of sand and gravel; minimum average transport velocity of particles was 0.42 ft/min. Minimum transport angle of particles moved by beach drifting and angular magnitude of the dispersion zone were studied also.—E.S.L.

8444 **Yates, Ann Marie.** X-ray fluorescence analysis of chondritic meteorites [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 712B, 1966.

Yochelson, Ellis L. *See* Schell, Elmer M.8347

8824 **Young, Addison.** Recent exploration in West Texas, *in* Oil and gas fields in West Texas—Symposium: West Texas Geol. Soc. Pub. 66-52, p. 10–11, 1966.

A brief resumé is given of petroleum exploration history, since World War II, of the major structures of the Permian basin.—E.S.L.

8886 **Young, L. L.; Neal, D. W.; Gaskill, D. L.** Waterpower resources and reconnaissance geology of sites in the Alsea River basin, Oregon: U.S. Geol. Survey Water-Supply Paper 1610-D, p. D1–D45, illus., tables, geol. map, 1966.

This report presents an evaluation of the potential waterpower in the Alsea River basin, Oreg. Geologic conditions at prospective damsites and reservoir sites are described. There are two possible sites for diverting Alsea River water to the Willamette River basin, one in the headwaters area of the North Fork Alsea River, and the other in the headwaters area of the South Fork Alsea River. These diversion possibilities are discussed.—W.L.G.

8343 **Zen, E-an; Ratcliffe, Nicholas M.** A possible breccia in southwestern Massachusetts and adjoining areas, and its bearing on the existence of the taconic allochthon, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D39–D46, illus., 1966.

The Everett Formation of the Taconic Range in western Massachusetts and adjacent areas overlies the autochthonous Lower Cambrian to Middle Ordovician

Stockbridge and the Middle Ordovician Walloomsac Formations; the structural nature of this contact is debatable. A discontinuous zone of carbonate rocks occurs between the Everett and the Walloomsac. The carbonate rocks, locally a breccia, are assigned lithically to the Stockbridge Formation. They are discordant with the surrounding rocks and are interpreted as tectonic slivers, thereby implying that the Everett Formation is allochthonous. Local structural relations indicate that the emplacement of the allochthon preceded both the formation of the earliest cleavage in the rocks and the metamorphism; the emplacement is pre-Acadian and may be the terminal episode of the Ordovician Taconic gravity sliding.—Authors' abstract

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